JANUARY 1985 VOLUME 11 NUMBER 1 $2.95

Creative Computing

THE #1 MAGAZINE OF COMPUTER APPLICATIONS AND SOFTWARE

The World's Smallest Circuits

IN-DEPTH EVALUATIONS:

Framework
Tandy Model 2000
ADDS PC/1
Dulmont Magnum
Genicom Printers
Amdek 5025 Printer
CorrectStar
ThinkTank
Habadex
Bank President
Biology Programs

PRODUCT PREVIEWS:

Data General/One
16-bit Apple IIx

Notebook Computers: New Products for Greater Efficiency

Industry Insider

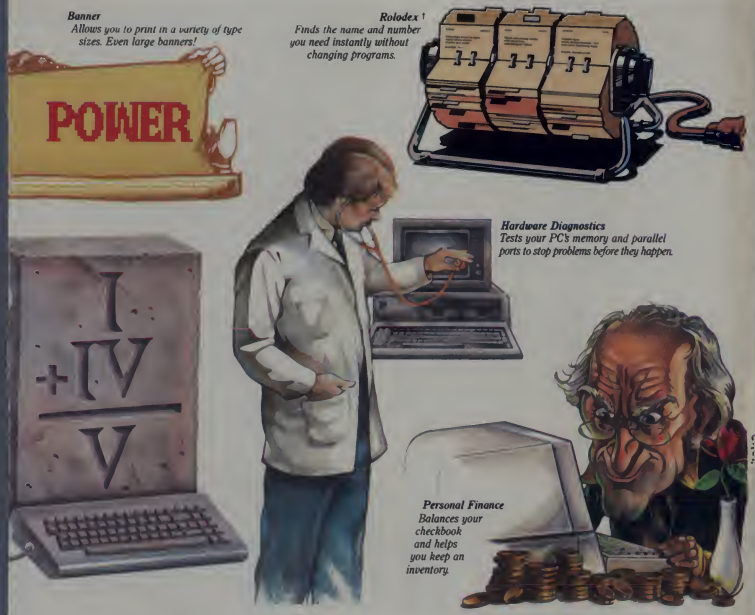
Multi-tasking With Your Apple

Assembly Programs for Commodore, Tandy, Atari

SPECIAL SECTION:

Choosing and Using Business Forecasting Software

CREATIVE COMPUTING VOL 11 NO 1 JANUARY 1985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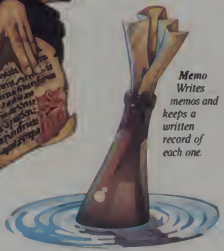

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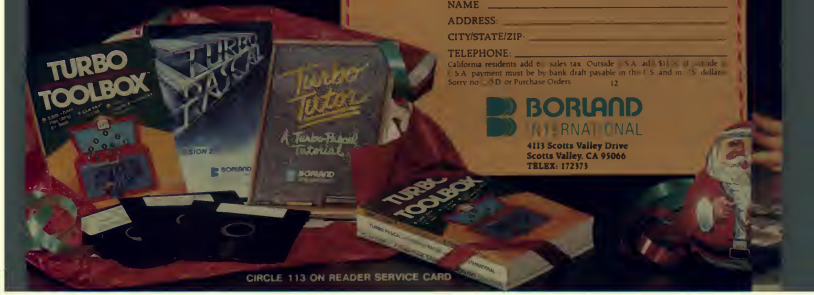

CIRCLE 113 ON READER SERVICE CARD

A BUREAUCRAT'S GUIDE TO WORD PROCESSING

Now, if it were you or I and we wanted a word processing program for our IBM-type PC, we'd probably stop off at our local computer store and simply diddle with a few.

You and I, however, are not the U.S. Department of Agriculture.

(Nor any of its permutations of subsystems like the Economic Research Service, National Resources Economics Division, Data Services Center, etc., etc.)

So when the USDA told ERS to tell NRED and DSC to look into a truckload of w.p. programs for all their PCs, the last thing they wanted was simple diddling. Their dedicated Wangs and Lexitrons were far too few to handle their needs, their IBM® PCs weren't compatible with them anyway, and nobody really, quantifiably, knew from word processing with a personal computer.

Definitely not a diddling-mode condition.

As they put it in The Exchange, an internally distributed publication of the Department of Agriculture: "A needs assessment showed that, in the long-term, a word processing system is needed that can increase word processing capability and also be compatible with ERS' Long Range Information Management goals."

Well, "Needs assessment" led swiftly to "procurement action," which galloped into an "objective review" of the eight top-rated PC programs on the market (as compiled by The Ratings Book published by Software Digest), along with WordStar® and Display Write 2, because they had some around.

Thus armed with the names, the final evaluators (a team of secretaries from NRED who would be the primary users of the PC software) became armed with each of the programs, along with checklists to record such things as ease of use, advanced features, and similarity to their existing dedicated equipment.

Since NRED has some hard disk base systems, any packages that were copy-protected could not be transferred to the hard disks, and were eliminated on that basis alone. OfficeWriter™ and SAMNA WORD™ II were the first to go.

Next, IBM's Diplay Write 2: because it's "not compatible with other software used in ERS (like Lotus™ 1-2-3,™ dBase II,® etc.)," and it's "full of confusing menu options and cryptic error messages." Au revoir IBM.

Then, three more, for a variety of reasons. Which left:

Volkswriter® Deluxe™
MultiMate™
Leading Edge™

Volkswriter® Deluxe? "Too complicated and confusing." Not "easy to learn or use."

MultiMate? Not bad. It actually tied the winner in a few categories.

The winner being the one that won 82% of the votes in the Ease of Use/Ease of Learning categories. The one about which they said, "The ability to store deleted text and automatic document backup features were both highly desirable." The one they thought they'd quickly "be able to use . . . for their day-to-day word processing tasks."

The whole process took some three months of work by people in DSC to support the NRED in its work with the ERS and DSC to make the world a better place for the USDA.

But the results were well worth the wait. Because at last they've solved their word-processing problems . . .

"With Leading Edge!"

THESE ARE THE PACKAGES THE COMMITTEE EVALUATED:

THESE WERE THE FINALISTS:

THIS WAS THE WINNER:
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COVER: Photograph by Dennis Kitchen.
Graphic enhancement by National Imagemakers Inc.

Creative Computing (ISSN 0 097-8siO) is published monthly at 3460 Wilshire Blvd., Los Angeles, CA 90010 by Ahl Computing, Inc., a subsidiary of Ziff-Davis Publishing Company, David Ahl, President; Elizabeth B. Staples, Vice President. Selwyn Taubman, Treasurer; Bertram A. Abrams, Secretary. 39 East Hanover Ave., Morris Plains, NJ 07950. Second Class Postage paid at Los Angeles, CA 90052 and additional mailing offices. Copyright © 1984 by Ahl Computing, Inc. All rights reserved. Editorial offices located at 39 East Hanover Ave., Morris Plains, NJ 07950 Phone (201) 540-0445. Domestic Subscriptions: 12 issues $24.97; 24 issues $43.97; 36 issues $57.97. POSTMASTER: send address changes to Creative Computing, P.O. Box 5214, Boulder, CO 80321. Call 800-631-8112 (toll-free in New Jersey call 201-540-0445) to order a subscription.

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CIRCLE 227 ON READER SERVICE CARD

INPUT/ OUTPUT

Neon Writes

The Neon Software Company, Inc., the manufacturer of Women's Ware, has written us in response to our review of Women's Ware in the September issue of *Creative Computing*.

Neon has informed us that *Filebox* has a suggested retail price of $49.95, not $79.95.

Neon has also advised us that Marie Norwood, Neon's Vice President of Customer Relations, was not the author of the Women's Ware instruction manuals. We want to clarify that the statements of opinion made in our review concerning the narrator and the narration of the manuals were not directed at Marie Norwood personally, but rather at the voice and tone of the "Marie" who narrates the manuals.

We regret any misunderstanding that may have arisen as a result of confusion between the fictitious "Marie" and Marie Norwood. —*EBS*

10th Anniversary

Dear Editor:

Congratulations for ten years of truly creative computing. Your magazine is without a doubt among the very best computer publications available. The tenth anniversary issue is outstanding. Thank you for allowing me to share the MITS Altair 8800 story with your readers. Much more about MITS and the Altair will be published next fall in Siliconnections a book I'm writing for McGraw-Hill.

Thanks for giving us *Creative Computing* during this historic decade. I'll look forward to reading every issue during the next decade.

Forrest M. Mims, III
309 Laurel Hill
San Marcus, TX 78666

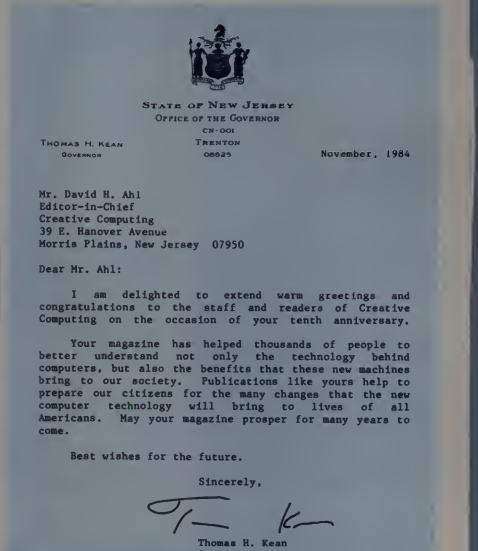
Required Reading

Dear Editor:

Your Tenth Anniversary issue of *Creative Computing* has just arrived. It is a masterpiece!

I have always been fascinated with the people and the stories of how we have come to where we are. Up to now I have had to rely only on brief mentions of the people involved. Now I have a source that provides background and insight into the people and how their lives revolved around micros.

From initial conception to final execution, I don't know how you pulled it off, but *you did it!* From Mims and Roberts, Leininger, Jobs and Wozniak, to Gates and Kapor, and more people than I ever knew existed—they're all there! Even five pages objectively de-



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November, 1984

Mr. David H. Ahl
Editor-in-Chief
Creative Computing
39 E. Hanover Avenue
Morris Plains, New Jersey 07950

Dear Mr. Ahl:

I am delighted to extend warm greetings and congratulations to the staff and readers of Creative Computing on the occasion of your tenth anniversary.

Your magazine has helped thousands of people to better understand not only the technology behind computers, but also the benefits that these new machines bring to our society. Publications like yours help to prepare our citizens for the many changes that the new computer technology will bring to lives of all Americans. May your magazine prosper for many years to come.

Best wishes for the future.

Sincerely,

Thomas H. Kean
Governor

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CIRCLE 175 ON READER SERVICE CARD

INPUT/OUTPUT (CONT'D)

voted to old Dave Ahl. This is the kind of stuff I've been aching for. I am overwhelmed!

Your work is required reading for all users. *Byte, Kilobaud, PC, PC World,* and *80Micro* should all make their readers aware of the results of your efforts.

Phil Salisbury
1711 Skylark Lane
Newport Beach, CA 92660

Omitting Quantum Leap

Dear Editor:

Congratulations on your first decade and good luck on your next. I am still reading the marvelous anniversary issue.

However, I did notice an omission in David Ahl's chronology of the personal computer. Under 1984 I didn't see Sinclair's New Quantum Leap. I would think the world's first under $500 computer featuring 32-BIT architecture, should merit at least an announcement.

Christopher Fenn
825 N. Lamb #237
Las Vegas, NV 89110

Tour Guidance

Dear Editor:

I purchased my Kaypro II in March, 1983, and my subscription to *Creative Computing* a few months after that. Eighteen months later, I have three computers and, thanks to your Tenth Anniversary issue, a much greater understanding of where I am today and just how I got here.

Each issue of *Creative* is insightful and informative, but this special compendium affords a unique perspective on past, present, and future.

Thank you for continuing guidance through this newest man-made jungle, and accept one very satisfied reader's best wishes for future decades.

D. Reid Powell
66 Maple St.
Guelph, Ontario NIG2G2

The Ultimate

Dear Editor:

The review of *The Ultimate* appearing in your October issue was both unfair and flatly incorrect on several basic points. *The Ultimate* was not designed simply for the Post Office's ECOM service. It was sold a year before ECOM existed. ECOM was added later. Furthermore, ECOM is not "discontinued." The system is alive and well.

The description of *The Ultimate* as weak, line-oriented and "quick and dirty" is unfounded. It is used without complaint at schools and universities throughout the country, and bundled by several major hardware dealers.

As to price, The Ultimate never sold for $495. It originally cost $275, counting rebate. It is now offered at $149.50. Your readers can obtain additional accurate information about this system by contacting us.

Bob Bosone, President
Computer Creations
6861 Convoy Ct.
San Diego, CA 92111
(619) 277-8822

I tested The Ultimate extensively while preparing the articles. I did not call the program "quick and dirty"; I said it was "good for quick and dirty jobs like memos or class notes." This is because it was very easy to enter and print simple text. As for ECOM, the instructions for The Ultimate were so specific that I didn't even try to use it with MCI Mail, which I use heavily. And while ECOM is alive, it is certainly not well.

—George Blank

Treasures For Teachers

Dear Editor:

Thanks so much for sending back issues of *Creative Computing* for my students. I recently received a shipment and want you to know how much I appreciate them.

We will be using the magazine for several sections of the class. I received the June 1984 issue which has the super section on Electronic Spreadsheets. I am going to have several of the students who are business majors review your other "special section" articles for business applications.

I also really liked the article, "The Perils of Computer Shopping," and we will discuss it when we talk about shopping for a home computer. We will also be able to use your reviews about the new computers. "Mathematics and Computer Art" will come in handy when I spend one lecture on art and music. And, of course, as we do some programming we will look at those particular articles.

Your generous offer of giving back issues to schools has really helped my class.

Cheryl Whitelaw
P.O. Box 1502
Cedar City, UT 84720

FOR ATARI AND APPLE

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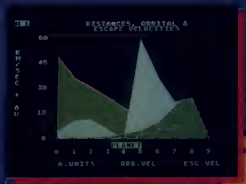

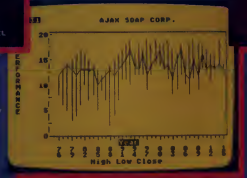

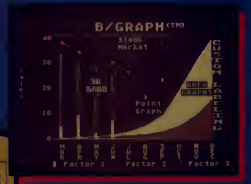

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Keyboard Confusion

Dear Editor:

The piece on Epson PX-8 by David H. Ahl (October, 1984) was interesting and informative. But on one matter egregiously misleading. Wrote the reviewer, "Layout of the keys is perfectly standard with no keys in unexpected places." This is true if you don't count the colon, the plus sign, the asterisk, the parentheses, the underline bar, the equal sign, the quotation mark, and the apostrophe.

What got into our Far Eastern Ally to so pointlessly and convulsively confuse the orthodox American typist? Don't ask me. When I called Epson to ask why it was that the reconfiguration had been done, the gentleman at the other end of the line had been unaware of the eccentricities to which I drew his attention. And when I asked whether there was a Smartkey that could reimpose normalcy on the keyboard, the gentleman didn't know the answer to that one either. To tell you the absolute truth, he did not betray very much agitation over the whole thing. He acted rather as if I had called in to say, Did he know that I had eleven fingers, instead of the normal ten?

Why do people do things like that to the inoffensive public? What have I ever done to Epson, save to adore it? Perhaps I was in violation of the Commandment against making graven images, and the Lord chose Epson itself (a divine pun) as the instrument of his displeasure with me.

Wm. F. Buckley Jr.
National Review
150 East 35th St.
New York, NY 10016

The "Modern" Prop

Dear Editor:

I was excited and challenged by your special *Focus on Japan* issue, August 1984. The range of articles and subject approaches was superior to the general run-of-the-mill pieces which have so frequently been put together on Japan and the Japanese in the field of computing.

I am especially interested in the concept of the computer and its marketing. This is why I found your little bit on the MSX symbols so interesting and yet revealing of at least one level beneath your fascination with the "absolute knockout" Sony girl. What your reporter did not note was that this "little girl" is Japan's biggest pop singing star, Mastuda Seiko, and the appeal of her face is enough to sell everything from her own records—certainly not sold on their musical merits I fear—to cosmetics, fast food, and computers.

I have my own rather extensive collection of Japanese computer advertisements pasted up on my cubicle *which* underscore the point that whether it is to the sumo wrestler, comedian, or orchestra conductor, the machine is seen as a "modern" prop without which life is not complete.

Theodore Cook
Suite 610
3801 Connecticut Ave., NW
Washington, DC

What do you get when you cross 1200 baud, free on-line time, and extra features at a price Hayes can't match?

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Data Rate?
The MultiModem gives you a choice—either 1200 or 300 bits per second. So you can go on-line with the information utilities. Check out bulletin boards. Dial into corporate mainframes. Swap files with friends.

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Yes. The MultiModem gives you features the Hayes Smartmodem 1200™ can't match. Features like dial-tone and busy-signal detection for more accurate dialing and redialing. Like a battery-backed memory for six phone numbers. All at a retail price of just $549—compared to $699 for the Smartmodem.

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CIRCLE 144 ON READER SERVICE CARD

ALL YE NEED KNOW.

Like:

"How many boxes of 'Trivial Pursuit' we got left in the West Coast warehouse?"

"Mr. Jones, your expense account just set an IRS record. Can you explain how, where, and with whom you managed to spend $12,648 on 'client entertainment'? In one week?"

"Listen, Eddie, we own 1,400 stores, and you're telling me you can't find one lousy Cabbage Patch doll?"

"We got any dealers in New England with a new Chevy Citation on the lot in metallic silver, blue interior, and stereo with cassette deck?"

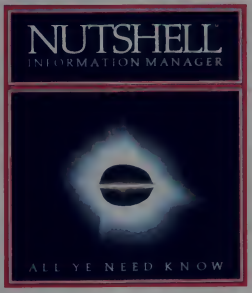
"Of all the furniture we sell, how many pieces in the $600 to $800 range haven't turned over this month?"

"I met this distributor in Chicago who wants to order a million units, and his name is McTavish or McCormack or McMurphy or McCarthy or something, and silly me, I lost the napkin I wrote his name on . . ."

And so on.

And so . . .

THE NUTSHELL™ INFORMATION MANAGER.



It stores and cross references any data your business depends upon—once an hour or once in a lifetime—and lets you get at it and use it in an instant.

It's an information-management software package created to take full advantage of all the power inherent—but until now never tapped—in sophisticated personal computers like an IBM® PC (upgraded to 256K) or a Leading Edge™ PC.

And it spans a major gap: Between toys that act like glorified file cabinets, on the one hand; and costly, complicated database management systems, on the other.

Now, the Nutshell™ doesn't pretend to give you all the information in the world. Just all the information you need, in any form you need it: inventory lists, invoices, sales reports, salary summaries, customer histories—with fields of virtually unlimited length—on the screen, or in printed reports.

To be sure, it's similar to a giant file cabinet. (In fact, depending upon your computer, its paper equivalent could be some 2 billion separate records, or 2 miles of printed information.) But there the similarities cease. Because you can access any data in any of those files by the most incredible cross-indexing system ever conceived for a PC. You can call up information by file name, date, prices, part number, manufacturer, description (like "red"), and a dozen other different ways in seconds.

Even if you forgot you had it.

Remember the incident concerning McTavish, McCormack, McEtc?

All you have to do is type in the first few letters of any name you want to recall (like "Mc") and every word in every file that starts with "Mc" pops up on the screen.

So you find "McGuire" and, along with his name, his million-unit order.

Where were you on that weird week of March 5, 1984 when you managed to expense $12,648? Type in 3/5/84 (or "$12,648" or "Polo Club"), and . . . here's your answer, Mr. Tax Man.

You can even selectively withhold certain information for display. (For example, you could show a customer every house your real-estate agency has for sale, without showing the owner's very lowest acceptance price.)

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CIRCLE 136 ON READER SERVICE CARD

DAVID H. AHL

INDUSTRY INSIDER

Home Market Woes

Many software publishers were hoping for a Christmas rally in sales that just didn't materialize. With nothing but clouds on the horizon last October, **Human Engineered Software** (HES) filed for protection under Chapter 11, **Synapse** sold controlling interest to **Broderbund, and Datasoft** laid off about 25% of its already pruned staff. Actually, these seemingly bleak moves may lead to leaner, stronger competitors in the future.

Within weeks of its Chapter 11 filing, HES was acquired by a venture capital firm that holds the controlling share of **Avant Garde** in Eugene, OR. After the reorganization, the two companies will merge management and marketing, although HES will continue to operate their production facilities in Brisbane, CA.

The two product lines are complementary. Avant-Garde markets productivity packages for the IBM PC and Apple, primarily through retail computer stores while HES markets home titles through mass merchandisers.

Likewise Broderbund and Synapse have complementary lines with Broderbund having strength in the Apple market and Synapse in the Atari market.

Datasoft recently sold a 40% share of the company to Gillette, a move that gave the company some cash but little else. Although the company licensed some popular coin-op titles from Namco (Dig Dug, PacMan, and Pole Position), pre-Christmas sales were still only about half of what the company hoped. As a result, the company cut ten people from its 45-person staff.

Sierra, in an attempt to unload some of its $250,000 of aging inventory of Atari and Coleco titles, has been selling packages in the Australian market for as little as $2 to $3 (wholesale). According to Sierra president, Ken Williams, U.S. retailers aren't interested at all—no matter how low the price. ■

Portables: Osborne Back; Gavilan Gone

Still operating under the protection of Chapter 11, **Osborne Computer Corp.** has announced its first new product, the Vixen. The system is manufactured by Advanced Technical Services and is expected to sell for about $1300. In addition, the company also plans to market a full-featured IBM-compatible notebook portable, the Encore. The machine was designed and will be manufactured by an outside contractor, Vadim. Incidentally, the machine may look familiar as it is also being marketed by **Morrow, Inc.** as its Pivot portable.

Meanwhile, plagued by year-long delays in bringing its machine to market, **Gavilan's** board of directors decided to shut down the company after they were unable to obtain additional financing. All told, investors have put over $31 million into the company and have little prospect of getting anything in return except, perhaps, one of the 1000 computers (finally working) left in inventory. ■

Poison to Some; Meat to Others

In the face of bankruptcies, layoffs, and product dumping in the home market, two traditional business software suppliers have decided to enter that sector. **Software Publishing** of Mountain View, CA, has introduced Commodore 64 versions of two of its productivity programs, **pfs:File** ($79.95) and **pfs:Report** ($69.95). Julie Wainwright of Software Publishing admits the move is "an experiment."

Ashton-Tate, maker of **Framework,** a top-of-the-line integrated software package, said it is developing a line of entertainment and children's educational software for various home computers. Nikki Hardin, formerly with Reston Publishing Co., has been hired to look into acquisitions and direct the development of new titles. In addition, the company recently announced a joint venture with **Scholastic.** ■

Random Bits

First yes, then no. The IBM PCjr "could appear in K-Mart stores before Christmas" said the newspaper story in late September. That was the word from **K-Mart.** Forget it, said the sharply-worded statement from **IBM** two days later. IBM called the report "erroneous" and said it has "no plans to expand its distribution channels to include mass-merchandisers."

Although **Honeywell** is selling the **Columbia Data Systems** IBM-compatible PC under its own label, the firm has not mentioned it and seems to be trying to avoid being linked with financially troubled Columbia. Columbia has restated its second quarter financial results twice; first it posted a $1.5 million profit, then a $2.5 million loss, and finally a $3.5 million loss.

New game from **Atari:** "Let's Make a Deal"? As Jack Tramiel tries to regain a position for Atari, scores of unhappy creditors left over from the Warner days are trying to recover their claims. Typical is Robert Clardy of **Synergistic Software** who claims he is owed $210,000 for work completed with $500,000 remaining on a contract.

Atari offered him $22,000 for work completed and $70,000 to finish a portion of the contract work. Clardy refused and proposed a compromise of $170,000. Forget it, said Atari; Clardy plans to sue. Other creditors tell similar stories. Even **Doyle Dane Bernbach,** Atari's former ad agency, has agreed to accept small monthly payments in settlement of its outstanding account—reportedly about $12 million.

And circling the globe with Canadian astronaut Marc Garneau aboard the space shuttle Challenger was a TRS-80 Model 100. The computer was used with a sunphotometer interfaced to the RS-232 port in an experiment to measure the density and distribution of the volcanic haze from El Chichon, a Mexican volcano. Let's hope Marc had some spare AA batteries. ■

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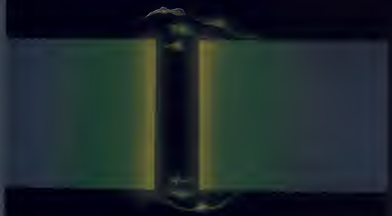

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THE CHALLENGE IS YOURS. TAKE IT

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RESCUE.

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SOLO.

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COMMODORE 64, ATARI, ADAM AND APPLE II.

ACTIVISION

CIRCLE 101 ON READER SERVICE CARD

BRIAN MURPHY

TELECOMMUNICATIONS TALK

Magazines on-line, new bulletin boards, and new products

Writing a magazine column is a little like burying a time-capsule. Because a column has to be done several months ahead of publication, the writer can only guess what the world will be like by the time his words reach his readers. Given the accelerated rate at which computer technology changes, the world may be a very different place in the summer from what it was in the spring. Looking a year into the future with almost any accuracy is almost impossible to do, as the plight of more than a few computer manufacturers attests.

Having said this much, it may seem a little foolish to say that I am using this forum in the first issue of the New Year to make a prediction of developments in telecommunications far into the future, but I intend to have a go at it anyway.

Here goes: In the next ten years I fully expect to see home computers with enormously enhanced processing power and with memory of from one to two megabytes. These systems will occupy the same (or less) space that a Commodore 64 does at present. I also expect to see printers specially designed for home use that render color graphics so faithfully that they rival four-color glossy magazine pages.

Picture this: The editorial and production staff of *Creative Computing* put the magazine together as they normally would with all the features, departments, and advertisements that you normally expect to see. The mechanicals of the individual pages are photographed for offset printing, and again for the office of Ziff-Davis Publishing Co. in Manhattan.

At Ziff-Davis, a laser scanner reads each page minutely, reducing the visual information into data which is stored on a hard disk. When the entire magazine is recorded, dubs of the disk are made for each of the computer information utilities which "distribute" *Creative Computing*.

Users who have the right home computer hardware are notified through E-Mail when they log onto the utility that *Creative* is on-line. They can then choose to load specific articles from the current issue for view on their ultra-high-res video monitors. Using a joystick or a mouse they can skip to any part of the page they choose. They can also opt to dump the article to a high-resolution color printer, which will print the material (including advertisements) with a clarity rivaling that of a four-color press.

This is all speculation (don't request this service for another few years, please), but I don't think that the scenario is too far-fetched. The technology required to achieve it is already partially in place, and the rest is not too far over the horizon. As it is, the time is already at hand when the home user can call up the full text of any article from a database containing the text of more than a hundred periodicals. And therein lies a tale . . .

Magazine ASAP

By the time you read this, a division of Ziff-Davis called Information Access Company will have produced and placed on line databases containing the full text of about 130 popular, industrial, and trade magazines which can be accessed through the average home computer/modem setup. The new databases are called Magazine ASAP and Trade and Industry ASAP. Access to these databases is available through Dialog Information Services, which already offers some of IAC's databases and which will be the subject of a future column.

As I write this, I have only a barebones outline of how the service will work and how the information product it produces will look on screen and in print (we'll do a thorough profile in a subsequent column). For now let me fill you in with the information I had just prior to the first demonstrations of the system.

Any user with a computer and a 300 or 1200 baud modem can connect to the system. A printer makes a very logical and desirable peripheral to the system as we shall shortly discover. Access to the system will be through Dialog using Telenet, Tymnet, Uninet, or the Dialog net which is expected to go into operation sometime later this year. The system will be accessed using the regular Dialog sign-on and database selection routines. Once you are in the ASAP database you will use special search techniques to find the articles you need.

Morris Goldstein, the president of IAC, says that the databases will be structured so that a user "with no technical knowledge can quickly conduct a computer literature search." As it has been described by IAC, you will be able to conduct searches by topic, author, publication name, company, product, or a plain language description. This is called the "controlled vocabulary" approach to indexing and searches. Your search commands will generate a bibliography of articles, from which you can select the ones you wish to see reproduced in full text.

IAC says that all relevant citations on the subject will be included, with "insignificant" citations deleted. According to IAC, their "rigorous indexing allows the user to restrict a search to only the most substantive articles on any topic or person to keep online costs at a minimum."

Once you have selected an article, as

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And there's much more with programs like NETMAIL, our person to person electronic mail; PEOPLESCAN, the nation's bulletin board systems; and on-line games including poker, blackjack, checkers, chess, backgammon, and bridge. (Color graphics are available for most popular computers.)

Whatever type of equipment you have — personal computer, terminal with modem — you can enjoy the excitement of PEOPLE LINK.

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I understand it, you can choose to see the article on your video monitor, dump it to your printer as it appears on screen, download it into memory if your communications software supports this activity, or order it to be printed off-line and sent to you by ASAP. No matter what sort of output you order there will be a charge for the access of the article (and an additional charge if the article is printed and mailed).

The next question is, who would be the most likely to benefit from a service

We're looking at a system designed for people with serious and specific research needs.

like this? The benefits to business users, professionals, and libraries should be so obvious as not to require description here. Among home users, students would probably find the system most useful. Not only does it save time in looking up citations at the library, but you enjoy the added benefit of having the full text of the reference material in your hands almost instantaneously.

I'm afraid I have very little to offer in the bottom line department. By the time this column reaches you, the tariffs should be set, but as of this writing (remember, this is a time capsule you're reading) all anyone at Dialog or IAC could say was "We'll wait and see what's decided." Given the fact that the most basic service of Dialog is $25 per connect hour (exclusive of database royalties, network connect charges, and long distance where applicable) we can reasonably expect the service to be expensive—certainly more expensive than going to the newsstand and buying a magazine, even if you live in Saskatchewan. So, unless my price prediction is way off base we're looking at a system designed for people with serious and specific research needs.

A note in passing: If you have a 1200 baud modem the tariffs will not hurt nearly as much. The system will transmit data at 300 and 1200. If you typically have large amounts of research to do, a 1200 baud modem would appear to be a necessity. You receive data roughly four times as fast as at the popular 300 speed, and your connect charges are correspondingly small.

As I promised before, I shall log onto the system and give you a full report on ASAP and Dialog service.

Some BBS System

A few columns back I invited readers who operated bulletin board systems to send in their phone numbers and a few details about their systems. The response was good, so here are some profiles of a few of the BBS systems we learned about.

W.L. Chaney is the sysop of T.H.A.T.S. (Terre Haute Atari Tele-Service), a 24-hour Atari bulletin board which he runs using his 48K Atari 800, three disk drives, and a 300 baud Hayes Stack modem. Chaney uses the Forem bulletin board software system to run his BBS. The number to call is (812) 299-9891. Chaney also operates a nighttime (6:00 p.m. to 6:00 a.m.) Apple II BBS called Mindstorm using the GABBS software system. The number to call is (812) 235-0908. Any computer can access either system.

George Matyaszek, a Chicago computer operations consultant, is a sysop for the Chicago Greene Machine, a TRS-80 Model I BBS with about six hundred users. The Greene Machine, which includes a Dial-A-Date System attracts about one hundred calls a day. The number for this 24-hour system is (312) 622-4442. The People's Message System of Santee, California, which keeps an updated register of BBS systems all over the country, recently coded this BBS as a "sexually oriented" system. We don't know why it was so designated (though it does have a dating service). Parents, use discretion.

I have no name connected with this next entry, but anyone who misspells my first name "Brain" can't be all bad, so here goes: Knight-Line is a Nashville, TN BBS which operates 24 hours a day at (615) 297-6037. It does not appear to be system-specific.

Ryan Katri of Fortuna, CA operates an Apple BBS called Johnny Appleseed. This BBS is a forum where users can review and exchange opinions about software and other computer products they have recently tried. The number is (707) 725-9202, and the board operates from 7:00 p.m. to 7:00 a.m. daily.

Michael Connick of Reston, VA is the sysop of Nova 100, a TRS-80 Model 100 users' group BBS. The board runs on a 24K Model 100 and is a support system for users of this computer in the Northern Virginia/Washington, D.C., area. This 300 baud system can be accessed with a Model 100 provided you set the TELCOM to M711E. Other computers set for 8 bit/no parity operation can also access this BBS. On weekends and holidays operation is 24 hours a day. On work days the BBS is up from 6:00 p.m. to 7:00 a.m.

My apologies to anyone I've left out in this roundup. We'll run your numbers in a subsequent column. For the rest of you sysops, get with it and send in your BBS numbers and a brief description of your system. If it's legitimate, we'll describe it here.

New Products

Hayes Microcomputer Products is jumping onto the IBM PC bandwagon with a new modem and communications software tailored for the IBM computer.

Smartcom II is a communications software package that can be used with the IBM PC and the Hayes Smartmodem 300 or 1200. A menu-driven program, *Smartcom II* can originate and answer calls and automatically log a user onto a remote system. Macros for logging onto The Source, CompuServe, Dow Jones News/Retrieval, and Dialog's Knowledge Index are included on the *Smartcom* disk. Other functions of *Smartcom II* include data capture and file transfer (including unattended transfer with another *Smartcom II* system).

The program supports up to 16 disk drives (including hard disk), operates with parallel and serial printers, and supports monochrome or color/graphics video displays. Hardware requirements include an 80-column monitor, at least one disk drive, 96K RAM, an asynchronous communications card, and DOS 1.10 or 1.00. *Smartcom II* retails for $119.

Anyone who misspells my first name "Brain" can't be all bad.

The new IBM modem is an adaptation of the fine Hayes Smartmodem 1200, designated the 1200B. This unit functions in the same way that a Smartmodem 1200 and IBM asynchronous Communications Adapter would, eliminating the need for the separate communications card.

The 1200B allows 300 and 1200 baud communications. Features include support of tone and pulse dialing, compatibility with Bell 212A protocol modems in asynchronous operation, support of user programs, a modular jack, a speaker (with volume control) to monitor the signal, and automatic calling and answering in the unattended mode.

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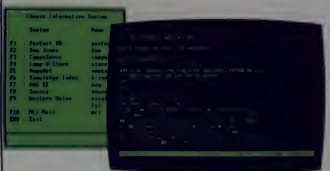

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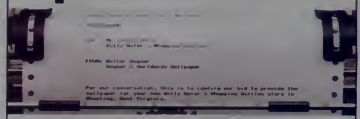

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CIRCLE 129 ON READER SERVICE CARD

Incidentally, if you buy the 1200B you can get *Smartcom II* as part of the package. The modem and software are package-priced at $599. The price includes the modem, modular phone cable, a plastic reference card, *Smartcom II*, the Hardware Reference Manual, and the IBM *Smartcom II* manual.

On-screen directions guide the user to select the correct databases and prepare the proper strategy for finding the information needed.

The Menlo Corporation is now marketing a very powerful software tool for Dialog Information Services users which promises to cut drastically the time users spend on-line with Dialog searching for article citations. Given the high cost of connection to an information broker like Dialog, the advantages of software like this seem obvious.

Called *In-Search*, the software works on Texas Instruments computers, IBM PCs, and PC work-alikes. *In-Search* is designed to simplify the process of searching for specific citations on the Dialog system. On-screen directions guide the user to select the correct databases and prepare the proper strategy for finding the information needed. Disks provided with the software are broken down into business, engineering, science, biology, social science, and medicine categories. They contain extensive information on the contents of the Dialog databases, allowing you to prepare your search strategy in great detail.

Once the search strategy has been formulated, it is formatted in preparation for the actual search. When you are ready for the real search, a single keystroke commands *In-Search* to log onto Dialog, selects the correct database, and begins the search process, following the preset format. If you encounter difficulties on the way, the software is designed to allow you to restructure the search quickly or to add additional qualifiers to the search parameters to narrow the focus of the search.

Once you have found the information you want, *In-Search* allows you to structure it on screen into long, medium, or short versions, without having to enter Dialog codes. If unfamiliar Dialog protocols appear on screen, or if you have trouble understanding an *In-Search* prompt, Help files provide excellent explanations and alternatives for action. Menlo claims that the Help files are so well organized that they eliminate the need for Dialog's reference manuals and training sessions.

Some of the other benefits provided by *In-Search* include a keyboard overlay to pinpoint program function keys, a Dialog password, and updates of database information transmitted over phone lines.

To use *In-Search* you need one of the above named computers with at least 192K RAM, two double density floppy disk drives (or one floppy and a fixed disk drive), and either a Hayes Smartmodem 300, 1200, 1200B or a Novation Smartcat. The price for the software package is $399. If you wish, you can get a demonstration program for $5 by calling Menlo at (408) 986-1200 during California business hours. Have your Visa or Mastercard at the ready. If you prefer, you may mail your $5 directly to Menlo at the address shown below. ■

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Dialog Information Services, Inc.
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(415) 858-2700

Hayes Microcomputer Products, Inc.
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Norcross, GA 30092
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Hayes 1200B w/Smart COMM II	395.00

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CIRCLE 112 ON READER SERVICE CARD

Two Billion Armpits Waiting For a Deodorant?

China has been much in the news lately because of Deng's moves toward capitalism. Deng Xiaoping, China's supreme leader, has even gone so far as to rewrite Karl Marx's famous dictum, "From each according to his ability to each according to his needs." Deng changed it, " . . . to each according to his work." But is this capitalism as we know it, and what is the meaning of it for the West? More particularly, what are the opportunities for trade in high tech products and computers?

I recently visited China with several invited speakers and leaders from the South East Asia Regional Computer Conference. We met with a delegation from the Institute of Computing Technology of the China Academy of Science and Technology. This group is responsible for computer science research, manufacturing, and promoting the use of computers throughout China. In a sense, this Institute is the IBM of China.

Although China has hardly been a leader in computing technology, they have managed to keep up with the rest of the world—albeit a few years behind. They built their first vacuum tube computer in 1953, first transistor computer in 1965, first IC (third generation) computer in 1971, and first LSI machine in 1981. Today, they are proud to boast that their Model 757 when used in vector mode has a speed of 1000 Mflops. This is an order of magnitude less than machines in the U.S. and Japan, but still quite respectable.

Not so encouraging is the fact that just 4000 mainframes and minis are in operation throughout the entire nation. This is about the same number as are currently in Baltimore, MD. In addition, the nation has about 30,000 micros, mostly in schools, and mostly obsolete units purchased from manufacturers in Hong Kong. In fact, an executive at one such maker boasted to me that he was selling 5000 machines a year to China with rubberized keys, no spacebar, 4K of memory, and an RCA Cosmep mpu. A machine like that would die on the shelves anywhere else in the world.

But perhaps that is indicative of the nation. China is a nation of one billion people, 800,000 of whom are still employed on the farms. Their farming methods haven't changed much since the 1600's. The few tractors they have are not in use on the farms where they might have some impact, but as transportation to and from town. Flying over the landscape, one has the impression of an alien planet: unpaved roads, virtually no moving vehicles, and virtually no light (a 25-watt bulb is a luxury).

Things began to change in 1978 when Deng and his allies began to gain control over Mao's chosen successor, Hua Guofeng. Among the first changes instituted by Deng was the dismantling of collectivized agriculture. Communes were disbanded and family farms restored; more important, a "responsibility system" was instituted that allowed peasants to sell goods from a portion of their land on the free market.

In 1979, experiments were started that allowed manufacturing enterprises to retain a small portion of their profits to use as local managers saw fit. Results were so good that the system is now being extended to firms throughout the entire nation. The new plan gradually abandons nearly all central planning in favor of an almost free market, although the control of key industries such as power generation and steelmaking will stay in government hands.

But as *The Wall Street Journal* said, "Capitalism it isn't." Pricing is still under control of the state, and it is not clear whether any, some, or all prices of goods and services will be allowed to rise to their full market value. That could make a big difference in the ability of the Chinese to develop or purchase the technology to improve their many inefficient and unprofitable factories.

Nevertheless, the country has accumulated hard currency reserves of $14 billion, and Deng's plans call for spending $1 billion in 1985 for the latest technology from the West. That's good news to scores of computer vendors who would like to replace each abacus in China with the micro of their choice. As one marketing wag said, China is "two billion armpits waiting for a deodorant" and the doors are now open.

Frankly, I don't think it is that simple. There are far more reasons for caution than for optimism. No one has been more successful in negotiating with communist nations than Armand Hammer of Occidental Petroleum. Yet his $600 million joint venture with China to produce the world's largest open pit coal mine has been stalled for years. And this is in the face of the admitted and almost desperate need of China for more energy; today nearly 20% of the nation's factory machinery stands idle for lack of energy.

Or take the two-year old deal in which China agreed to purchase 6 million tons of wheat annually from the U.S. Harvests improved in China, and they sought a way out of the deal. They found it in our textile import quotas which they said were "unfair," and used that to repudiate the wheat deal.

I believe we must make a much greater effort to understand the Chinese people before we will be able to successfully deal with them. In the meantime, it is far better to err on the side of caution when dealing with the largest and oldest civilization on the face of the globe. ■

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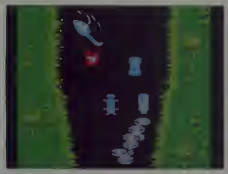
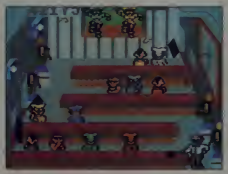


Bally Midway's Spy Hunter puts you in the driver's seat of the hottest machine on four wheels. You're after enemy spies. The situation is life and death. You'll need every weapon you've got – machine guns, and guided missiles, oil slicks and smoke screens. But the enemy is everywhere. On the road, in the water, even in the air. So you'll have to be more than fast to stay alive in Spy Hunter. You'll need brains and guts, too.

Do you have what it takes?



Bally Midway's Tapper would like to welcome you to the fastest game in the universe.

You're serving up drinks in some of the craziest places you've ever seen. And the service better be good, or else. You'll work your way through the wild Western Saloon to the Sports Bar. From there to the slam dancing Punk Bar and on into the Space Bar full of customers who are, literally, out of this world.!

Are you fast enough to play Tapper? If you have to ask, you probably already know the answer.

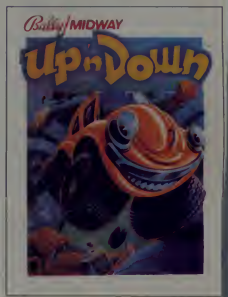
Bally Midway's Up 'N Down by Sega. In this game, a crash is no accident.

In fact, it's the whole object of the game. You'll race your baja bug over some of the worst roads south of any border. Leap dead ends, gaping canyons and oncoming traffic in a single bound. And if anyone gets in your way, crush 'em.

Crashing, bashing Up 'N Down. It's one smash hit that really is a smash.

The #1 Arcade Game of 1984.

Nominated as Most Innovative Coin-Op Game of 1984 by *Electronic Games* magazine.



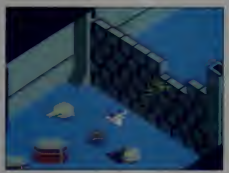
#1 Arcade Hit, *Play Meter* Conversions Poll, 8/1/84.

WERE SUCH BIG HITS, THEM HOME.

Sega's Congo Bongo rocked the home game world when it shot up to Number 3 on the Billboard chart this spring.

And now it's available for even more home systems. So check the chart and get ready for jungle action. You'll pursue the mighty ape Congo up Monkey Mountain and across the Mighty River. Do battle with dangerous jungle creatures. Ride hippos, dodge charging rhinos and try to avoid becoming a snack for a man-eating fish.

Congo Bongo. It's fast and it's fun. But be careful. It's a jungle in there.



Sega's Zaxxon. If you haven't played Zaxxon, you must have been living on another planet for the past few years.

And now the ultimate space combat game is available for even more home systems. You'll pilot a space fighter through force fields and enemy fire on your way to do battle with the mighty Zaxxon robot. Countless others have gone before you in this Hall of Fame game. But this time your life is in your own hands.

Zaxxon killed them in the arcades. But compared to what it will do to you at home, that was child's play.

	SPY HUNTER	TAPPER	UP 'N DOWN	CONGO BONGO	ZAXXON
Atari 2600 cartridge	✓ NEW	✓ NEW	✓ NEW	✓	✓
Atari 5200 cartridge				✓	✓ NEW
Atari Computers* cartridge	✓ NEW	✓ NEW	✓ NEW	✓	✓ NEW
Atari Computers† diskette	✓ NEW	✓ NEW	✓ NEW		✓
ColecoVision & ADAM cartridge	✓ NEW	✓ NEW	✓ NEW	✓ NEW	✓
Commodore 64 cartridge	✓ NEW	✓ NEW	✓ NEW	✓	✓ NEW
Commodore 64 diskette	✓ NEW	✓ NEW	✓ NEW	✓ NEW	✓
Apple II, IIe, IIc diskette	✓ NEW	✓ NEW	✓ NEW	✓ NEW	✓
IBM PC diskette	✓ ** NEW	✓ ** NEW	✓ ** NEW	✓ ** NEW	✓ ** NEW

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*Atari 400, 800, 600XL, 800XL and 1200XL (Congo Bongo cartridge: 400, 800 and 800XL.)
† Atari 800, 600XL, 800XL and 1200XL
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The Little Laboratory that Does Big Things

The National Submicron Facility

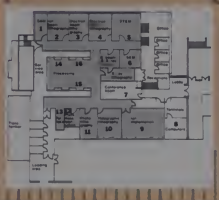
In the beginning, there was ENIAC. ENIAC, short for Electronic Numerical Integrator and Computer, was the world's first electronic digital computer. It was built less than 40 years ago by a team of engineers at Bell Laboratories and was considered a marvel of its age, a herald of things to come.

Now, with the wisdom of hindsight, we see ENIAC as an important, essential development, but also as nothing more, nothing less than a 30-ton 20,000-square-foot-pocket calculator. It took more than 50 engineers and technicians and nearly 18,000 vacuum tubes to keep it running, and at best it could perform 5000 calculations per second.

By contrast, today's microcomputers, which fit on a desktop and contain not vacuum tubes but solid-state circuitry, routinely perform more than 1,000,000 calculations per second: a factor of 200 improvement in less than 40 years—an unparallelled achievement in the history of human invention. And, as if to impress even the most jaded science fiction fan, researchers have developed experimental silicon chips which themselves can perform more than a *million* calculations in a single second—all in an area the size of an infant's fingernail. Elements of the individual electronic switches (or "gates") in these highly integrated silicon chips can be as small as 1500 Angstroms (one Angstrom equals one ten-billionth (10^{-10}) meter, or approximately 1/25,000,000 (2.5×10^{-7})inch).

These developments herald the emergence of a new technology: the technology of the ultrasmall. This "hot spot" of current research is a world whose largest dimension is one micron, or one millionth of a meter, and whose smallest dimension is equal to the width of a small cluster of hydrogen atoms. In this world, engineers and scientists study the intermediate range between bulk solid-state

The outside of the Knight Laboratory. The wall of windows at left are staff offices. Note that there are no windows toward the right, where the laboratory itself is located.



Floor plan of the Knight Laboratory. The shaded areas indicate the clean area, which is class 400.

Far right: Positive-air-pressure laminar-flow hoods, which filter air down to Class 10. Note that the staff member is wearing regulation lab coat, bonnet, and booties.

physics and subatomic physics—atoms and ions in small clusters or crystals, or in ultrathin layers—where the physics and potential applications of matter may be startlingly different from anything we have seen before.

Through innovations and improvements of technologies such as digital electronics, chemical and biological microsensors, optical wave-guides and fiberoptics technologies, submicron research is laying the foundation for the next wave in what is now commonly referred to as the "microelectronics revolution." A laboratory at Cornell University, the National Research and Resource Facility for Submicron Structures (or National Submicron Facility), is leading the way for the United States' progress in this exciting and important new technology.

The National Submicron Facility is a pioneer institution. Established by the National Science Foundation in 1977, it remains the only laboratory where any qualified U.S. researcher can come to use the highly specialized and expensive tools of submicron science and technology. These researchers—scientists and engineers in fields ranging from electrical, chemical, and materials engineering to physics to medicine and agriculture—come to the Facility to utilize equipment and other resources unavailable elsewhere. Together with the staff of the Facility, they explore the microworld with a freedom heretofore only dreamed of. The results so far have been stunning:

- The world's smallest artifacts: letters so small that using them you could reproduce all thirty volumes of the *Encyclopaedia Brittanica*, on a postage stamp;
- A device that can measure the change in the earth's magnetic field caused by the blink of an eye;
- A wire so thin that it "traps" electrons—it no longer conducts electricity, but acts as an insulator instead. Or, if you prefer, a gas so dense that it becomes a metal and conducts electricity; and
- Electronic devices so small that 30,000,000 of them would fit on a single ¼-inch-square chip.

These results and others have established the National Submicron Facility as a laboratory that defies superlatives and where the extraordinary begins to seem almost commonplace.

Not the least of the marvels of the National Submicron Facility is its research laboratory, the Lester B. Knight Laboratory, named for a Cornell alumnus and patron. The building itself stands out from others on the Cornell campus. Visitors who fly into Ithaca, NY, on a clear day, or who view the Cornell campus from its bell tower or another lofty building, invariably comment on the giant, 30-foot <μ logo outlined in colored crushed rocks on the laboratory roof: the National Submicron Facility is, quite literally, submicron!

To those uninitiated in submicron research, a visit to the Knight Laboratory is apt to hold one surprise after another. You must meet the submicron world on its own terms, and the Knight Laboratory is designed to provide an environment in which macroscopic scientists and engineers can adapt to the needs of their microscopic research. For example, inquisitive visitors often wonder why there are no windows throughout most of the laboratory. The walls stretch unbroken and white, and the building, glistening in the sun, resembles a giant sugar cube. The windows were left out, we are told, to minimize thermal imbalances caused by weather.

You enter the Knight Laboratory via a reception area that is ordinary enough and sign a guestbook. To your right are the computing and computer design facilities, the only technical facilities situated in a "normal," unaltered environment. A quick look around reveals an impressive array of computing power: a Digital Equipment Corporation VAX11/750 computer with several graphics peripherals, including a Grinnell Color Frame Buffer for ultra-high-resolution color graphics imaging, plotters, and graphics terminals. There is also a CALMA computer-aided design system with high-resolution color

The Micron "Ruler"

A micron, or micrometer, is denoted by the Greek letter mu, μ, and is one millionth of a meter. In other words, $10^{-6}m=1\mu$. At the National Submicron Facility, it serves as a convenient unit of measure.

The range in dimensions of different micro-fabrication projects is highlighted in the examples pictured.

Above: Human hair, $^{3}/_{1000}$ inch thick, superimposed upon integrated circuitry. A typical electronic "gate" within the circuitry would be one micron, or $^{1}/_{100}$ the diameter of the hair.

Right: The wires in a typical integrated circuit may run 2.5 microns thick.

terminals, run by a Data General Eclipse S280 computer. The computer facility is generally one of the busiest places in the laboratory, with people working in it 24 hours a day, seven days a week.

Submicron research encompasses three general operations: the design, fabrication, and analysis of microstructures. Design work using computers is the only technical operation in the National Submicron Facility that does not require a specialized environment. Fabrication and analysis of microstructures are done in the main research area within the Knight Laboratory, called the clean room.

The Knight Laboratory clean room is rated Class 400, which means that there are fewer than 400 half-micron or larger particles in every cubic foot of air (for contrast, normal office air is Class 300,000). The clean room also contains 24 superclean laminar-flow hoods in which the air is filtered down to Class 10 or better. The precautions are understandable: A single small dust particle can look like Mount Rushmore when you see it sitting on top of your carefully developed experiment.

You can enter the clean room only through an airlock, a special passage that isolates the laboratory from the dirt and grime of the outside world. The air pressure inside the airlock is higher than that in the reception area, so that dust is blown outward when the door is opened. A large sign warns, "No Smoking, Eating, or Drinking." Other rules include: no cosmetics, no writing implements other than ballpoint pen, no bare legs (in the summer time), and no cleated hiking boots (in winter).

You don special clean room clothing: booties, bonnet, and a lab coat. You pass through yet another door (more air blows outward), and enter the laboratory proper.

People pass by, shuffling in their booties. Your guide explains that there are usually anywhere from 15 to 30 people in the laboratory at any given time: Facility staff, Cornell faculty and graduate students, and students and researchers from other university, industrial, and government laboratories who have come to the Facility to conduct research. Regular staff and students wear blue lab coats; novices and visitors wear white. If there is a problem, you look for someone wearing blue.

The laboratory from floor to ceiling is a panorama of stark, spotlessly white surfaces. There is a low but continuous humming noise from equipment and air conditioning—after a few minutes in the laboratory, you cease to hear it. A common sight is the hose to the vacuum cleaner, a giant, snakelike contraption that coils around itself as the janitress disconnects it from one outlet of the immense vacuum system and plugs it into another. (Needless to say, in a laboratory so dedicated to cleanliness, such mundane functions as vacuuming and laundry take on a new importance. The Facility's laundry bill alone comes to several hundred dollars each month.)

The 7500-foot-square clean area is composed of a large central room that houses machines for such "large scale" processes as evaporation and ion milling. Around it are 12 smaller rooms which house the instruments that perform the very delicate and precise fabrication and analysis of structures so small that the largest is $1/100$ the diameter of a human hair.

Because vibrations from traffic on the roads near the Knight Laboratory could ruin a delicate experiment, each of the smaller rooms rests on its own pad of "floating" concrete, $2\text{-}1/2$ feet thick, isolated from the foundation and adjacent rooms. In addition, the entire building rests on a foundation of specially-compacted earth to insulate it further from vibration.

The basement of the Knight Laboratory houses the support system for the building, including special air and water purification systems and a complicated electronics system that feeds each room individually. It is a huge room, a jungle of pipes and wires and cylinders that seems to stretch on in all directions. The central air conditioning unit, AC-1, with its banks of high density filters, sits along one side like a stranded

Above: A researcher working with photo lithography equipment. To the left are the projection and contact photolithography equipment used to etch "larger" structures of about 0.7-1.0 microns. These structures may be augmented or embellished by further processing to provide even smaller detail.

A researcher working at the Facility's Cambridge electron-beam microfabrication system. This instrument uses a beam of electrons to "write" patterns on electron-sensitive substracts, according to a computer-generated program, and has a resolution down to approximately 0.1 micron.

Transmission optical micrograph of an electron-beam exposed and wet-etched chrome mask for magnetic bubble-memory device fabrication. Minimum dimension in this research is 0.5 micron. The mask was generated using electron-beam lithography.

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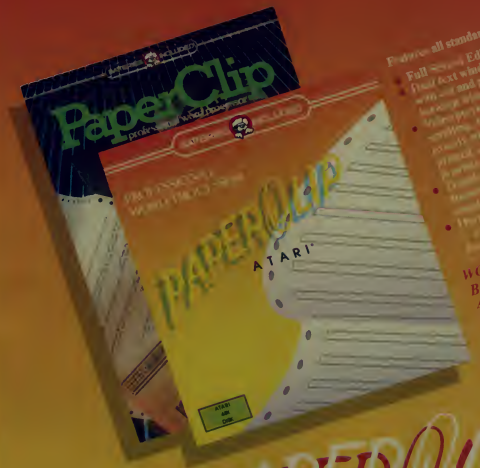

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Pullman railroad car. It recirculates the air within the entire Knight Laboratory twice each minute. There are also four auxiliary air conditioners for specific areas within the building, as well as a 700 gallon deionized water tank. A monitoring panel for all of the support systems is visible through the glass-walled airlock. It has dozens of dials and lights—green when all systems are "go" and red if there is a failure, in which case there is also what the guide calls an "impressive" alarm system.

The Knight Laboratory is an engineering and design marvel in itself, and yet it is only the setting for something even more marvelous: an array of highly specialized equipment that fewer than ten laboratories in the world can match. Scientists use one machine to build submicron devices by sandwiching together superthin layers of materials. They use another to take a single ion and "implant" it at a specific position within a crystal: the properties of the crystal change dramatically with the position of the impurity. Yet another machine is used to etch amazingly tiny and intricate patterns into semiconductor material to study techniques for making new and better integrated circuits.

Some of the machines fill entire rooms with their wires and coils—a scientist working at one looks like Captain Nemo at the helm of the Nautilus. Visitors are often surprised to see that such big machines are used to study such little things. The machines are large because, despite the elaborate precautions taken within the Knight Laboratory itself, they must be incredibly stable when working with single atoms and atomic distances.

"Users come to our laboratory and are often astonished at the variety of equipment that is here for their use," comments Edward Wolf, director of the Facility and professor of electrical engineering at Cornell. "Not just equipment, but expertise: our staff and, of course, Cornell faculty and students, provide a unique and exciting interdisciplinary research environment. Many of the people our visitors meet are acknowledged world leaders in their fields."

Wolf feels that a national laboratory is an idea whose time has come, especially in a field such as submicron research, where even the most basic tools of the trade are enormously expensive. The facts certainly seem to bear him out: less than three years after the Knight Laboratory was completed, the Facility now hosts over 40 user projects from university, government, and industrial laboratories throughout the United States, as well as nearly 40 more from within Cornell. Another primary objective in establishing the Facility was to foster graduate research in submicron fabrication. Here, too, numbers speak louder than words: more than 100 advanced degrees have been granted to students working at the Facility, and more than 150 students may be conducting research at the Facility at any given time.

Many of the non-Cornell users visit for one to three weeks several times a year, working intensively with the equipment and expertise not available elsewhere. The Facility also participates in Cornell University's Program on Submicrometer Structures, Prosus, an industrial affiliate program, which seeks to establish closer ties between industry and the academic community.

Wolf sees the alliance between government, academe, and industry as a crucial one for the United States. "The recent tax credit legislation for corporations interested in university research and instrumentation has really stimulated our university-industry interaction," he explains. "The exchange of ideas, resources, and personnel allows us to get much, much more out of every dollar that we spend on research—and I don't have to tell anyone how important that is."

As has been the case in other frontier fields, for example, astronomy, technology and basic science go hand-in-hand in submicron structures research. Advances in one lead to advances in the other, and progress occurs quickly and in often unexpected directions. It is like the old chicken-and-egg story: which comes first, novel computing techniques

photo by John Krumjuan

photo by John Krumjuan

Dr. Peter Kruskus and Dr. Jaime Nulman have developed silicon devices with gates as small as 0.2 micron using a combination of silicon technologies including this furnace which selectively "grows" very thin layers of silicon dioxide.

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which allow the creation of new microstructures, or novel microstructures which lead to advances in computing? For this reason, nearly all of the research in the National Submicron Facility involves some innovation in computing and computer engineering. Some examples of work at the National Submicron Facility which may lead to new submicron structures for integrated circuitry include:

- The development of materials specially configured for ballistic transport in semiconductors and metal silicides with unusual properties or with properties which make them suitable for specific uses;
- The development of new fabrication techniques, such as reactive-ion-beam etching, an anisotropic process which combines both chemical and physical etching mechanisms to create submicron structures impossible to achieve through traditional "wet" etch processes;
- The pushing of "conventional" fabrication and analytical technologies, such as electron-beam lithography and scanning transmission electron microscopy, to their limits;
- The application of "conventional" technologies to new areas, such as bubble-memory devices;
- The investigation of basic physics as applied to microcircuitry: such problems as electromigration (current-induced atomic transport, a significant failure mode in highly integrated circuitry) and parasitics (the creation of unintentional coupling and other false

Professor Michael Isaacson and coworkers using the scanning transmission electron microscope (STEM) at the National Submicron Facility to produce structures down to 0.0015 micron (1.5 nanometer).

Computer Related Research at the National Submicron Facility

Submicron structures research, as applied to computer science, engineering, and other fields, generally investigates fabrication techniques and materials which may result in smaller circuit devices. As individual device size decreases, more devices can fit in a given area, and more sophisticated logic and memory pathways can be developed.

The research summarized below illustrates two major categories of submicron research which may one day be applied to computers: advanced silicon research and research into the creation and applications of semiconductors other than silicon.

It should be remembered that the projects described below are only two out of more than 90 projects currently in progress at the Facility. Readers wishing to learn more about the projects or about other aspects of the National Submicron Facility are invited to write to Professor Wolf at the address given at the end of the accompanying article.

Advanced Silicon Technology

"We are working to understand and control the geometric and electronic characteristics of ultrasmall structures," reports Peter Krusius, a Cornell professor of electrical engineering, "and apply that basic science to tomorrow's integrated circuitry." Krusius hopes that this science will one day enable engineers to produce silicon chips with as many as 30 million devices packed onto their half-inch-square area. The components will have feature dimensions in the range of 100 nanometers (a nanometer is 10^{-9} meter).

Together with research associate Dr. Jaime Nulman and others, Krusius works with existing and novel technologies to create new types of silicon devices, as well as methods for refining existing devices. In research on silicon MESFET (field-effect transistor with a metal semiconductor control gate) and MOSFET (metal oxide semiconductor field-effect transistor) devices, they have demonstrated the fastest reported switching speed yet obtained for MESFETs.

They obtained this by developing new and complex techniques for fabricating devices with gate lengths as small as 200 nanometers. These techniques were an amalgam of "classical" submicron silicon technology, each step pushed to its resolution limit: technologies such as electron-beam direct-writing, reactive-ion etching (a dry etching process), ion-implantation, and a novel pattern transfer technique based on selective oxidation of aluminum were used to fabricate submicron gates as small as 200 nanometers.

Figure 1 is a scanning electron micrograph of a silicon MESFET ring oscillator circuit, a device with a gate length of 0.9 micrometer and a switching speed of 220 picoseconds (a picosecond is a trillionth of a second), the fastest switching speed for silicon MESFET devices yet reported. This work was supported by the National Submicron Facility and the Semiconductor Research Corporation. Since scaling theory shows a limit of 30 picoseconds for this technology, Krusius and his group are now studying the fabrication of MOSFETs with gate lengths as short as 150 nanometers.

Semiconductors Other than Silicon

Lester Eastman, a professor of electrical engineering at Cornell, graduate students Lovell Camnitz and William Jones, and others use molecular beam epitaxy (a process by which ultrathin atomic layers are "sandwiched" together) to create new materials for use in integrated circuitry. In particular, they are investigating circuit devices known as MODFETs, in which the atomic layers are arranged so that the electrons

Figure 1. Micrograph of silicon circuit device developed at the National Submicron Facility with a switching speed of 200 trillionths of a second and a gate length of 0.9 micron. (Note scale in lower left.)

The molecular-beam epitaxy system, which Professor Lester Eastman of Cornell and others use to create new types of semiconductor materials by sandwiching together ultrathin layers of elements such as gallium (Ga) and arsenide (As).

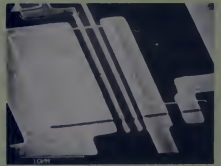

Figure 2. Micrograph of logic device with gates only 0.4 micron in size.

Figure 3. Ring oscillator fabricated using the molecular-beam epitaxy system.

from a heavily doped aluminum gallium arsenide (AlGaAs) layer are separated from their donor ions and trapped in a "potential well" which is formed when AlGaAs (high potential energy) is grown onto undoped gallium arsenide, GaAs (lower potential energy). Because the electrons are separated from their donor ions in a MODFET structure, there are fewer collisions, leading to a higher attainable electron mobility and peak saturation velocity. In other words, electrons in these so-called "ballistic" semiconductors travel much faster than electrons in conventional semiconductors, such as silicon. Electron mobilities as high as 150,000 cm^2/v-sec have been measured at 77°K on MODFET layers grown at Cornell.

Submicron circuit elements made from these modulation doped structures exhibit high gain (or current handling capability, g_m) and very fast switching speeds. In research supported by IBM, Jones has fabricated logic devices with g_m's as high as 250-300 mS/mm (milliSiemens/millimeter: a Siemen is a measure of conductance) at room temperature (300°K) and devices with near-state-of-the-art switching speeds as fast as 22 picoseconds. Recently, in other research supported by IBM, Camnitz has measured world record g_m's of 400 mS/mm at room temperature and 550 mS/mm at 77°K on submicrongate, high frequency microwave transistors fabricated on a newer configuration of the modulation doped layer structure. It is anticipated that logic devices fabricated on this new structure could switch in less than 5 picoseconds at room temperature with very low power dissipation.

Figure 2 is a scanning electron micrograph of a NAND gate logic device (designed and fabricated by Jones) with 0.4 micron dual gates in a single channel. This device was designed for use in a frequency divider logic circuit that would operate in the Gigahertz (GHz) frequency range.

Figure 3 is a scanning electron micrograph of an 11-stage enhancement-mode ring oscillator (also designed and fabricated by Jones) with delay time, τ_d ~22 psec. The material is AlGaAs/GaAs MBE grown. This ring oscillator has a gate length of 0.45 microns defined by electron-beam lithography.

elements in complex circuitry), as well as field-emission studies of ions, which could eventually lead to *ion*-beam lithography; and

- Improved image processing design and analysis capabilities.

Researchers interested in using the Facility's resources should first contact Professor Wolf. A User's Manual is available upon request; outlines both the criteria for projects of the Facility and lists the equipment and other resources available to users. Criteria for Facility user projects include:

- A project should involve microminiaturization, especially in the submicrometer regime, in a substantial and innovative way;
- A goal of the project should be to advance significantly the art of submicrometer technology or its application to engineering or to scientific research;
- The chief purpose of the project should not be to make use of services that are available commercially;
- The nature of the project should be such that the specialized equipment or expertise available at the Facility will make an essential and important contribution to the outcome of the work;
- The project should provide educational opportunities for personnel associated with the work.

The user community of the National Submicron Facility now includes university, industrial, and government laboratories from throughout the United States, including: Carnegie-Mellon University, University of Florida—Gainesville, University of

The lettering above was etched in Na Cl (table salt) by the electron beams of the STEM. The 15 nanometer scale equals. 0.015 microns. At this size, the entire Encyclopedia Brittanica could fit on a postage stamp.

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Wolf encourages anyone with an interest in using the resources of the Facility to get in touch with him: "In addition to academic, government, and industrial laboratories, small businesses involved with advanced technology might benefit greatly from interaction with the Facility, as might researchers in "non-traditional" fields such as biology, medicine, and agriculture." Anyone interested in receiving more information about the National Submicron Facility is invited to write him: Professor Edward D. Wolf, Director, National Submicron Facility, Knight Laboratory, Cornell University, Ithaca, NY 14853.

The National Submicron Facility has generated much excitement throughout the technical community, and there is a steady stream of visitors—as many as 30 in a single week—from laboratories throughout the world. The popular media have also adopted "the little laboratory that does big things," and articles have appeared in such diverse publications as *Newsweek*, *Barrons*, *Popular Science*, and *National Geographic*. WCBS and WIXT-Syracuse have both managed to produce television segments about the Facility despite the difficulties of preparing camera equipment for the clean laboratory. One reporter, when meeting Ed Wolf for an interview, exclaimed, "But you're such a big guy to be working on such little things!" Wolf, who once played basketball for Kansas State, grins, "I guess he thought it was a lab for small scientists instead of small science." ■

photo by John Koumjian

Above: A staff member at work at the new CALMA CAD system.

Left: A staff member working at the Scanning Auger Microprobe, an instrument used for extremely precise elemental analysis of microstructures.

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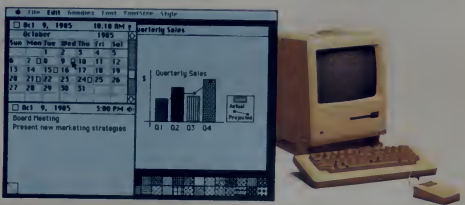
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Speed, Style, and Support

Tandy Model 2000

Tandy presents a small business computer with sleek styling, advanced technology, and excellent graphics.

When we unpacked the Tandy Model 2000, we were pleasantly surprised by its sleek dimensions. After years of seeing boxy TRS-80 models swathed in battleship gray, the sleek white exterior of the Model 2000 really caught our eye. And lest you think beauty is only skin deep, we hasten to add that the Model 2000 incorporates several advanced features that make it a serious contender in the business marketplace.

Unlike its Radio Shack predecessors, the Model 2000 consists of three components: a display, detachable keyboard, and system unit.

System Unit

Tandy seems to have designed the Model 2000 with convenience in mind. Set into the front of the system unit are the power and reset switches, both recessed to avoid accidental pressing. This is certainly a pleasant change from switches that require you to reach around the back of a system unit to turn the machine on and off.

Furthermore, most other computers force you to remove the cover to install expansion boards. Not so the Model 2000. At the rear of the system unit, four metal plates held on by plastic clips cover the four expansion slots. Installing an expansion board entails pulling off a plate and inserting the board horizontally (not vertically) into the machine. It is fast and simple.

What is not so simple, and certainly inconvenient, is getting the graphics expansion board ready for installation. The monochrome graphics board comes ready to install, but the color graphics board requires extensive preparation before you plug it into the rear expansion slot.

Photographs by Jeff MacWraith

Actually, the monochrome and color graphics boards are the same board. If you add the Color Graphics Option Kit to the monochrome graphics board, you get a color graphics board. This means you must plug 16 chips into the appropriate sockets on the board, all the while double checking that the pins line up and the chips are oriented correctly. You see, according to the manual, "if you insert the chips incorrectly, you will destroy the board."

Tandy 2000 (continued)

Even worse, you must cut a trace (wire) on the board with an X-acto knife. In addition, our graphics board had six hand-wired modifications, that is, a wire stretched between two chips and soldered into place. The word that comes to mind is "kludge."

The entire procedure is not difficult, but why should the user have to worry about building and possibly frying a board? Note that Tandy recommends that you have the Color Graphics Option Kit installed by a qualified technician. Also note that you will pay extra for the installation. The choice is up to you.

Our unit also came with a 128K RAM board, which does not fit into an expansion slot. The manual notes that the board "requires Radio Shack installation." Well, not quite. You must remove the cover, being careful that the electronic innards do not spill all over the floor, but the board inserts easily into the machine.

De Fault in Default

The system unit houses two floppy disk drives, stacked vertically, which store a whopping 720K each. The drives use a two-piece door to lock a disk in place. You push the disk in and pull down the top part of the door. When you want the disk out, you press the bottom part of the door inward, which releases the top part and trips a spring that ejects the disk. Frankly, a rotating knob would have been good enough.

Unlike other computers, Tandy uses the lower drive as the default drive. Unfortunately, it is not labeled as such on the machine. If you try to boot the system from the top drive, absolutely nothing happens. No error message. No disk drive light. No keyboard response. Absolutely nothing. We thought we were in the Twilight Zone.

Once you do patch everything together, the Model 2000 runs like a charm. The 16-bit 80186 microprocessor, a development of the 8086, operates at 8 MHz and reformats text and recalculates spreadsheets with amazing speed. The Model 2000 completed Ahl's Simple Benchmark Test in seven seconds, with an accuracy rating of 0.005859375 and a random number rating of 7.2.

The system unit also contains built-in parallel and serial ports and a monochrome monitor interface. The system performs a reassuring self-test upon power up.

Tandy includes a clever touch in the system unit. The unit sits practically flush with the table as do most other desktop computers. However, a portion

Once you patch everything together, the Model 2000 runs like a charm.

in the front of the system unit is slightly raised, leaving a storage space big enough to tuck half the keyboard out of the way.

Keyboard

The Model 2000 keyboard is connected to the system unit by a three-foot coiled cord. Tandy placed the connector underneath the raised portion of the system unit on the back wall of this storage space. You must lift the unit to plug in or unplug the keyboard—a bit awkward, but if the computer usually stays on one desk, this presents no problem at all.

On the plus side, this means the keyboard connects to the front of the system unit, which is much more convenient than looping the cord around from the rear.

The keyboard is as sleek as the sys-

HARDWARE PROFILE

Name: Tandy 2000 **Type:** Small business computer **CPU:** 16-bit 80186 **RAM:** 128K (expandable to 768K) **Keyboard:** Detachable, 90 keys, slant adjustable **Display:** 80 x 24 characters; 640 x 400 pixels **Disk drives:** One or two 720K, 5.25" floppy drives or one floppy drive and one 10Mb Winchester **Ports:** One RS-232 serial and one parallel **Dimensions:** System unit: 18.7" x 16" x 6" Keyboard: 16.2" x 7.7" x 1" Display: 13.7" x 12.5" x 15.1" **Operating System:** MS-DOS **Documentation:** Introductory booklets and loose-leaf applications manuals **Summary:** Advanced design features excellent graphics **Price:** Base system 128K RAM, two floppy drives, $2750

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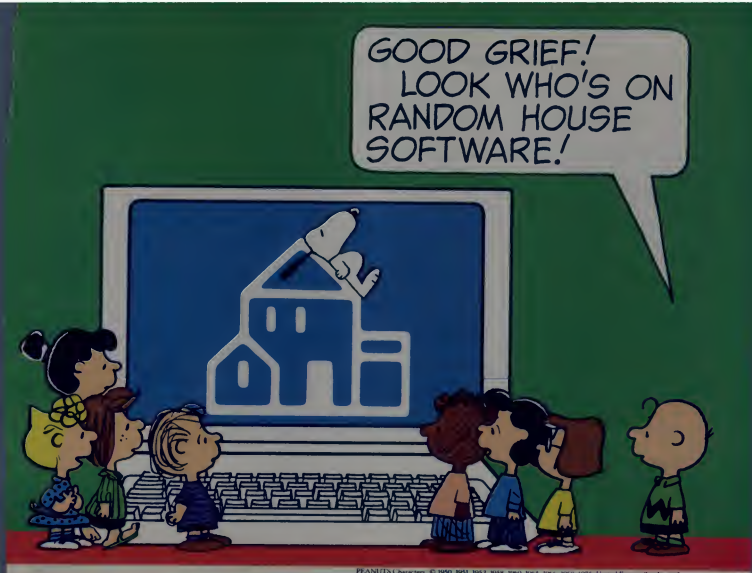

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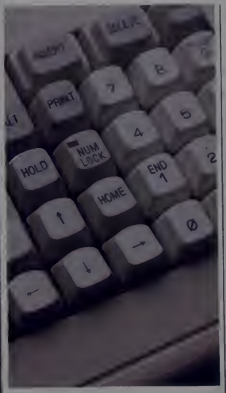

tem unit and extremely light. The alphanumeric section of the keyboard uses standard Selectric layout, although we prefer larger Shift keys. The numeric keypad only partially doubles for cursor control with Page Up, Page Down, and End. The other keys on the keypad are the tilde, accent mark, backslash, and vertical em dash.

The keypad includes a separate Enter key and a raised bump on the 5 key for fast data entry. However, conspicuous by their absence from the keypad are the addition and subtraction keys, an omission which may slow down data entry. The Insert, Delete, and Break keys are above the numeric keypad.

The rest of the cursor control keys are crammed between the alphanumeric keys and the numeric keypad. Three of the four keys are arranged in logical diamond formation, with the down arrow placed in between the left and right arrows.

Twelve function keys stretch across the top of the alphanumeric section of the keyboard. Above the function keys, slight depressions hold plastic cards that remind you what the function keys stand for. Tandy provides the plastic cards, but any cardstock will do.

Overall, the keys have a good feel, although they tend to have a soft touch. Aural feedback is fair, sounding a subdued click with each keystroke.

Display

Our evaluation unit came with a 14" RGB color monitor. Tandy calls it the CM-1 High Resolution Color Display monitor. We call it dynamite.

Character resolution of the CM-1 is 24 lines of 80 characters. The character set is the same as on an IBM PC, including 96 ASCII letters, numbers, and symbols, with an additional 140 foreign, mathematical, and graphics characters.

The display has a sharp graphics resolution of 640 by 400 pixels in eight colors from a 15-color palette using the high resolution graphics option. You may also hook up the Model 2000 to a color television set and use a medium graphics resolution of 320 by 200 pixels in four colors. The high resolution monochrome option (with VM-1 monitor) displays either 640 by 400 pixels or 640 by 200.

All the expected graphics statements and commands are implemented in Microsoft GW Basic, which is a refinement of Microsoft Basic for MS-DOS operating systems and includes special graphics and sound capabilities.

The CM-1 monitor has an adjustable three-position steel bar to tilt the monitor five or ten degrees for viewing comfort. The contrast, brightness, and horizontal centering knobs are concealed behind a panel on the front of the monitor. There is also a separate power switch, located on the front of the monitor.

Our evaluation unit came with a 14" RGB color monitor. Tandy calls it the CM-1 High Resolution Color Display monitor. We call it dynamite.

Operating System

The Model 2000 uses the popular MS-DOS from Microsoft, which is used on the IBM PC and virtually all other 16-bit microcomputers. Tandy includes Microsoft GW Basic and a rudimentary maillist program (written in Basic) on the MS-DOS disk.

Software

Although Tandy compares the Model 2000 with the IBM PC, if you are looking for complete PC compatibility, you may want to look elsewhere. Just about every off-the-shelf PC software package we tried on the Model 2000—business, education, and entertainment—failed to run.

Tandy posts a list of 42 PC programs that are suppposed to run on the Model 2000 without modification, including Peachtree accounting packages, IUS accounting packages, and Open Systems accounting packages. There is also a list of 49 packages that do not run on the Model 2000—a list to which we can certainly add.

The speed difference between the 80186 microprocessor and the 8088 saves you time and makes you appreciate the Model 2000 even more.

The main source of Model 2000 software is Tandy itself, which modifies and repackages successful programs. The samples provided with the machine included *Lotus 1-2-3*, *MultiMate*, *MultiPlan*, and *MAI Inventory;* all four packages worked perfectly the first time around. However, the Model 2000 version of *MultiMate* does not include a spelling checker at this time, although Tandy says that a new version is under development.

Other software packages available that we did not get a chance to try are the pfs series, Microsoft *Word*, *dBase II*, Infocom *Planetfall* and *Witness*, and Microsoft Pascal compiler and Fortran.

The speed difference between the 80186 microprocessor and the 8088 saves you time and makes you appreciate the Model 2000 even more.

Documentation and Support

The introductory booklet that comes with the Model 2000 is adequate, although it leaves us hungry for more information about the computer. The booklet provides a quick overview of using MS-DOS commands, running the maillist program, and troubleshooting problems. Tandy also includes a quick reference booklet for MS-DOS commands.

The Basic, MS-DOS, and software specific manuals contain more extensive and detailed information. The applications manuals seem to be the standard guides issued by the manufacturers, re-

worked slightly to take into account differences that take advantage of the features of the Model 2000.

As for accessibility of support, you have only to ask yourself "how close is my local Tandy Computer Center?" Easy access to support and guaranteed compatibility and availability of peripherals and software have long been among the strongest selling points of Tandy/Radio Shack computers.

Pricing

The Tandy Model 2000 carries a competitive price of $2750 for a base system with 128K RAM, two 5.25", 720K floppy disk drives, one serial port, and one parallel port. The base system with a 10Mb hard disk in place of one floppy drive carries a suggested retail price of $4250.

The high resolution monochrome graphics board carries a suggested retail price of $449, and the color graphics kit

Tandy has already converted enough successful and reliable business programs to satisfy the needs of most users.

sells for $199 more. An additional 128K RAM for internal installation is $299, and a 128K RAM expansion board (fits in an expansion slot) costs $499.

The VM-1 monochrome monitor costs $249, while the CM-1 RGB color monitor sells for $799. A tilt and swivel monitor pedestal for the VM-1 is $89.95. A mouse controller board and clock calendar cost $119.95, and the mouse itself costs $99.95.

Decisions, Decisions

As you can tell, we like the Tandy Model 2000, especially the excellent graphics capability for a business computer. We found it inconvenient at first to remember that the bottom disk drive was the default drive, and we think that the graphics board should come assembled, but we did get used to the drives, and tinkering with the board presented no major problems.

We are certainly impressed with the speed of the Model 2000. This is a real benefit when reformatting text, recalculating spreadsheets, and sorting databases. As with any new machine, the scarcity of software can be a problem. However, Tandy has already converted enough successful and reliable business programs to satisfy the needs of most users.

We caution you not to consider the Model 2000 an IBM PC compatible. It is not and was never meant to be. Look to the Tandy Models 1000 and 1200 for PC compatibility, but not the Model 2000.

All in all, we commend Tandy for making an advanced machine. It is fast, offers many features, and sports a competitive price. Business people and professionals looking for an office computer backed by the legendary support of Tandy should consider the Model 2000. ■

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Subsidiary of NCR counts on customer loyalty to make the PC/I a success

ADDS PC/I

Although new to the personal computer market, Applied Digital Data Systems, a subsidiary of NCR, is no newcomer to the computer field. The company started selling computer display terminals in 1969 and boasts an installed base of more than 500,000 terminals worldwide. Indeed, ADDS is marketing the PC/I primarily to this base rather than to the first time small business user—although it certainly will not turn away a customer.

Like the IBM PC, the PC/I consists of three components: display, detachable keyboard, and system unit housing the cpu, disk drives, and electronic innards of the system. The PC/I also offers a few features not found on the IBM PC.

System Unit

The system unit sports the same boxy lines as most PC compatibles, holds two half-height disk drives, and displays the corporate name twice. So far, nothing special. However, ADDS places a reset button on the front panel of the system unit, a practical improvement over the IBM PC. Should a program freeze up the system and the usual Ctrl-Alt-Del sequence prove ineffective, a quick press of the reset button saves you the trouble of turning the system off and on.

Inside the system unit, the usual 16-bit 8088 microprocessor, 256K RAM, and 16K ROM (expandable to 48K) reside on the motherboard. The PC/I supports the 8087 numeric co-processor, and five expansion slots allow you to install memory, modem, and other expansion boards. One serial and one parallel port are standard.

In running Ahl's Simple Benchmark Test, the PC/I performs the test in a respectable 18 seconds, with a 0.005859375 accuracy rating, and a random number rating of 7.2.

The system unit also houses two half-height disk drives—again, with standard 360K storage capacity for floppy disks. For those with larger requirements, an optional 10Mb Winchester hard disk drive is available. While the floppy drives on our machine worked flawlessly, they made an awful racket when they were accessed.

The PC/I goes through a reassuring diagnostic self-test each time you power up the machine.

Keyboard

The detachable ADDS PC/I keyboard is basically a carbon copy of the IBM PC keyboard. It connects to the system unit via a six-foot coiled cord. The keyboard is slant adjustable; it has three height settings—one more than the IBM PC keyboard. The keys are well sculpted, and the feel of the keyboard is fair to good. Keystrokes are quiet, with little aural feedback.

Most of the fortes and foibles of the IBM PC keyboard apply to the ADDS PC/I keyboard. The Shift and Return keys are not in their proper places; there is no Enter key on the numeric keypad; and cryptic arrows, rather than English labels cover the Tab, Backspace, Return, and Shift keys. ADDS does include

Photographs by Jeff MacWright

LEDs on the Num Lock and Caps Lock keys. The keys on the numeric keypad double as cursor control keys and include Home, End, Page Up, and Page Down functions.

ADDS also smoothed over the ridge running along the top of the keyboard, an unwise move since you cannot prop a book or manual between the keyboard and system unit.

Display

The PC/I supports three types of monitor: monochrome, composite color, and RGB color. Our unit came with a 12" monochrome (green) monitor, but ADDS sells amber and soft white screen monochrome monitors as well.

The monitor mounts on a pedestal that tilts roughly 20 degrees upward and swivels all the way around from side to side. This helps position the screen for the most comfortable viewing angle. Contrast and brightness knobs adjust the display, and a separate power switch lets you turn the monitor on and off independently.

We also connected a Sakata RGB monitor to the video display and color graphics adapter. It worked without a hitch.

Like the IBM PC, the ADDS PC/I flickers while scrolling. However, to our eyes, the PC/I flicker seems more pronounced than that of the PC. Also, the video cable connecting the monitor to the system unit is not long enough to permit the monitor to swivel fully if you place the monitor at the side of the system unit. Of course, this is not a problem if you place the monitor on top of the system unit.

Character resolution is 25 rows of 80 characters, with the character set the same as that of the IBM PC. The display has the usual IBM PC graphics resolution of 640 pixels by 400 pixels in monochrome and 320 pixels by 200 pixels using four colors. Graphics statements and commands are implemented in Microsoft GW Basic, which is a refinement of Microsoft Basic for MS-DOS operating systems that includes special graphics and sound capabilities.

Software

The true measure of IBM PC compatibility is how much software will run on the compatible. Overall, the PC/I runs most off-the-shelf IBM PC software, including business, educational, and entertainment programs. Indeed, ADDS sells more than 100 software packages and claims that titles are being added regularly.

The standard measure of IBM PC compatibility is running *Lotus 1-2-3*. Unfortunately, the PC/I failed to run version 1 A. We tried both the supplied operating system (Microsoft MS-DOS 2.11) and regular PC-DOS 2.0, but *1-2-3* failed to run. Thus, if you are thinking of purchasing a PC/I and want to run a specific IBM PC program, try before you buy.

The International Touch

ADDS touts its PC/I as a truly international computer. The company offers five foreign language keyboards: French, German, Italian, Spanish, and Swedish. Likewise, the company offers

HARDWARE PROFILE

Name: ADDS PC/I **Type:** Business computer **CPU:** 16-bit 8088, 4.77 MHz **RAM:** 256K (expandable to 640K) **ROM:** 16K (expandable to 48K) **Keyboard:** Detachable, 83 keys, slant adjustable **Display:** 80 x 25 characters; 320 x 200 pixels **Disk drives:** One or two 360K, 5.25" floppy drives or one floppy drive and one 10Mb Winchester **Ports:** One serial and one parallel **Dimensions:** System unit: 17.3" x 16.4" x 5.7" Keyboard: 17.8" x 7.5" x 1.2" Display: 13.5" x 13.5" 14.8" **Operating System:** DOS + (MS-DOS) **Documentation:** User's guide booklet **Summary:** Another IBM PC compatible. **Price:** Base system 256K RAM, two floppy drives, $2445.

Manufacturer: Applied Digital Data Systems
100 Marcus Blvd.
Hauppauge, NY 11788
(516) 231-5400

ADDS PC/I (continued)

foreign language versions of the DOS + (MS-DOS) operating system. ADDS plans to release a full line of foreign language translations of software.

Documentation

ADDS includes an Operations Manual—a 60-page booklet—that provides an overview to the system. It is illustrated and contains general instructions on setting up the system, navigating around the operating system, and coping with errors. Some technical information is also included.

Pricing

ADDS offers two configurations of its computer, the PC/I and the PC/II.

The PC/I includes 256K RAM, two floppy disk drives, built-in parallel and serial ports, and a video display and color graphics adapter for $2445. The 12" monochrome monitor sells for $205.

The PC/II is the exact same machine as the PC/I except it replaces one floppy drive with a 10Mb Winchester. It costs $3995. Again, the monochrome monitor costs an extra $205.

Does it ADD up?

ADDS is targeting the business professional who already owns an ADDS terminal as its primary customer. The company figures the user is looking for a stand-alone computer that virtually guarantees the ability to replace the terminal and connect to a mainframe. Of course, we are sure ADDS will not turn away a first-time, small business user looking for a PC compatible.

The rear panel of the PC/I. Note the five expansion slots and serial and parallel ports.

ADDS admits the hardware differences between the PC/I and IBM PC are minimal. They point out that their computer includes a tilt/swivel pedestal, built-in graphics board with monochrome, composite color, and RGB color display options, and built-in parallel and serial ports. And you get all this hardware at a competitive price.

All this is true, but—and this is a very big but—the PC/I may not be the compatible for you if you expect your computer to run off-the-shelf IBM PC software. In our tests, *Lotus 1-2-3* version 1A did not run, although several other programs did. Our advice with the PC/I, as with other compatibles, is to try a particular package first to be assured of complete compatibility.

All in all, we did like the ADDS PC/I although we question the degree to which it is truly compatible with the IBM PC. Still, businesses and professionals, especially those already using ADDS terminals, would do well to consider the ADDS PC/I. ■

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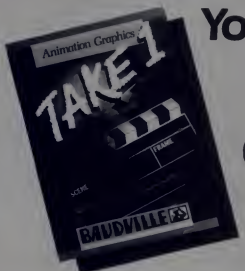

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Radio Shack Educational Software Catalog 1985

Radio Shack's Commitment to Education

A Wide Selection of Field-Tested Programs

Radio Shack involves the experts—teachers, curriculum developers and administrators—in designing and field-testing our complete line of TRS-80® courseware. Compare our courseware with other programs currently available. You'll see what a difference a commitment to quality can make.

We Meet Your Total Classroom Computing Needs

Radio Shack's TRS-80 microcomputer is a valuable teaching tool widely used in schools nationwide. We have a major commitment to support educational uses of the TRS-80 by producing a growing list of instructionally-sound courseware. We provide training and support, including free computer training classes, courseware manuals designed for educators who have never worked with a computer, and 26 Regional Educational Coordinators.

Radio Shack TRS-80 Classroom Courseware

Children's Computer Workshop

Designed by the CTW Software Group, a division of Children's Television Workshop, these two packages are for use with first and second graders. Each requires a TRS-80 Color Computer disk system and includes diskettes, teacher's guide, game boards, posters, spirit masters and activity cards.

Play-With-Language™ (Cat. No. 26-2538, $99) consists of three word and reading activities to teach sight and vocabulary words, decoding and comprehension skills. **Hands On!™** (Cat. No. 26-2639, $99) lets students write with beginning word processing aids and create and manipulate pictures in ways unique to computer art.

New! Classroom Courseware from MECC

Ten popular programs developed by the Minnesota Educational Computing Corporation. Many include a manual containing learning objectives, lesson plans, student exercises and worksheets. Choose **Basic Arithmetic** (26-2790, $44.95), **Word Games** (26-2791, $44.95), **Expeditions** (26-2792, $44.95), **Puzzles and Posters** (26-2793, $44.95), **Graphing** (26-2794, $34.95), **Music** (26-2795, $34.95), **Pre-Reading** (26-2796, $34.95), **Earth Science** (26-2797, $34.95), **Marketplace** (26-2798, $34.95) and **Outdoor Biology** (26-2799, $34.95). MECC programs 26-2790 thru 26-2793 require a 48K Model III or Model 4 disk system. Programs 26-2794 thru 26-2799 require a Color Computer with 32K Extended Color Basic.

Computer Assisted Reading Development

Adapted from the successful Philadelphia Computer Assisted Reading Development Program for students with reading problems at the 4 to 8-grade level . TRS-80 AUTHOR I Lesson Presentation Package (26-2707) or TRS-80 AUTHOR I (26-1727) and a Model III or Model 4 disk system are required. Network 3 compatible using the TRS-80 Network 3 AUTHOR I Lesson Presentation Package (26-2713).

Choose from **C.A.R.D. I: Sentences** (*26-2603, $199), **C.A.R.D. II: Paragraphs** (*26-2604, $199) or **C.A.R.D. III: Directions** (*26-2605, $199.00).

Reading Series

The programs in our **High Motivation Reading Series** are written for grade levels 4–6. With four student readers and a read-along audio tape. Require a Model III or Model 4 disk system and TRS-80 MicroPILOT™ (26-2718).

Select **Charles Lindbergh/Amelia Earhart** (*26-2513, $74.95), **The Hound of the Baskervilles** (*26-2514, $69.95), **Dracula** (*26-2515, $69.95), **Moby Dick** (*26-2516, $69.95), **The Beatles** (*26-2517, $69.95), **20,000 Leagues Under the Sea** (*26-2518, $69.95), **Time Machine** (*26-2519, $59.95), **Frankenstein** (*26-2520, $59.95), and **HMRS Student Records System** (26-2521, $29.95).

Introduction to the Alphabet (*26-1718, $39.95) helps 4 to 6 year-olds learn the alphabet and computer keyboard. Available on cassette or disk for Model III or 4.

Hall of the Mountain King (*26-2616, $39.95) action game. Classroom version lets students answer any multiple-choice quiz as they play. Requires Model III, or Model 4 disk system or 16K with cassette. Network 2 compatible.

Learning is Fun and Easy With Our Electronic Book

Our (26-3141, $24.95) makes learning fun. Different areas of the book's touch-sensitive surface are pressed to interact with the computer as the child makes activity selection or answers question. Each of the software packages contain software and colorful pages which are inserted into the Electronic Book.

Each program teaches different concepts. Plugs into joystick port. Requires 16K. Select from these six different packages: **Professor Pressnote's Music Machine** (26-2573, $24.95), **Solar Explorer** (26-2546, $19.95), **Word Wizard** (26-2544, $19.95), **Shape Maker** (26-2542, $19.95), **Maze Master** (26-2541, $19.95) and **The Number Factory** (26-2543, $19.95).

Model III Courseware Will Run on a Model 4 in Model III Mode
***Network 3 compatible**

History and Social Studies Courseware Packages

Basic Illustrated History of America Learning Unit (26-2645, $299) includes twelve illustrated books on American history—from 1500 to the 1980's. TRS-80 AUTHOR I Lesson Presentation Package (26-2707) or TRS-80 AUTHOR I (26-1727), and a Model III or 4 disk system required. Network 3 compatible using 26-2713.

Our two **History of Technology** packages use colorful graphics, text, sound effects and recorded speech. Requires 16K Color Computer, TV and cassette recorder.

Pioneers in Technology (26-2624, $94.95) includes The Age of Flight, Space Exploration, and History of Computers. **Inventions That Changed Our Lives** (26-2625, $94.95) includes Edison's Electric Inventions, Bell and the Telephone, and The Age of Television.

The Next Four Years: Electing the President (26-2664, $19.95) helps students study and understand the American election process. A 32K Model III is required.

Challenging Math and Science Courseware

K-8 Math Series of programs supplements regular classroom math instruction in kindergarten through eighth grades. Include summaries and a K-8 Math Cross-Reference

The **K-8 Math Program, Vol. I** (*26-1715, $199) provides random drill and practice problems in number concepts and basics. A Model III or Model 4 cassette system is required.

The **K-8 Math with Student Management, Vol. I** (*26-1725, $199) combines the K-8 program with a student management capability. A Model III or Model 4 disk system is required. Printer is optional.

Our **Color Math** (26-3202, $39.95) automatically places students in lessons at their skill level. A Color Computer with a 32K disk or 16K cassette system is required. Network 2 compatible.

The **K-8 Math Worksheet Generator** (26-2162, $99.95) prints worksheets and answer sheets from K-8 Math lessons. A Model III or Model 4 disk system and TRS-80 line printer are required.

Secondary Math and Science

Our **Essential Math Program, Vols. I and II** are drill and practice programs for grades 7-12 and are available on cassette or disk for Model III and Model 4. **Essential Math, Vol. I** (*26-1716, $199) includes exercises in addition, subtraction, multiplication, division, and more. **Essential Math, Vol. II** (*26-1719, $199) covers fractions, decimals and percents, and pre-algebra concepts.

Euclid Geometry Tutor (*26-1724, $39.95) lets students practice constructing proofs using nine basic postulates.

Advanced Graphics (*26-1714, $39.95) gives practice in analyzing equations, and plots graphs of functions and polar and parametric equations.

Vector Addition (*26-1720, $39.95) illustrates and plots components and sums of student-provided vectors. **Vector Addition for the Color Computer** (26-2638, $39.95) requires Extended BASIC and is available on cassette or disk.

Interpreting Graphs in Physics: Position and Velocity vs. Time (*26-1721, $39.95) poses graph-related questions.

Graphical Analysis of Experimental Data (*26-1722, $39.95) plots data pairs that the student inputs.

Investigations in Integral Calculus (*26-2600, $39.95) graphs and computes areas of functions. **Investigations in Integral Calculus for the Color Computer** (26-2641, $39.95) requires Extended BASIC and is available on cassette or disk.

Plane Analytic Geometry (*26-2602, $39.95) includes problems on straight lines and conic sections.

Number Theory (*26-2613, $69.95) includes definitions, examples and exercises on number theory concepts.

Matrices, Determinants, and Simultaneous Equations (*26-2620, $49.95) generates problems related to simple matrix algebra.

Quadratic Equations (*26-2623, $49.95) covers coefficient recognition, discriminant evaluation, and more.

The Solar System: Featuring the Discovery of the Planet Pluto (26-2647, $59.95) combines graphics and recorded speech to present facts about the planets. A 16K Color Computer, TV and cassette recorder are required.

Not including Color Computer programs, the above are available on cassette or disk for Model III and Model 4.

The **TRS-80 Chemistry Lab** uses graphics and equations to simulate chemical reactions. Students control variables.

TRS-80 Chemistry Lab, Vol. I is available on cassette or disk for Model III and Model 4 (*26-2609, $199), and on cassette for the Color Computer with Extended BASIC (26-2626, $199). **Additional Student Experiment Books** (26-2666, $3 each) are available.

Help Prepare Students for the World of Business

Our **Corplan™** business simulation program (*26-2619, $49.95) gives instructors an effective way to demonstrate the many facets of business management. Corplan realistically simulates the operations of a company. Requires no previous knowledge of computer operation or business programs. Requires a 48K Model III or Model 4 disk system. An optional printer can be used to produce copies of the program's charts and reports.

Our **Numeric Data Entry Practice** (*26-2601, $39.95) is a 25-lesson practice course to help students develop speed and accuracy in entry of numeric data using a 10-key pad. It requires a 32K Model III or Model 4 disk system. Printer is optional.

Business Education (26-2654, $599.00) supplements business accounting curriculums. Requires 48K Model III or 64K Model 4 2-disk system. Printer required.

*Network 3 compatible

Radio Shack's Computer Education Series

Complete **Basic Programming** classroom packages for secondary and post-secondary levels include overhead transparencies, a teacher's manual and 25 student workbooks.

Part 1: Introduction to BASIC (26-2150, $220) introduces students to the TRS-80 and BASIC. **Additional Student Workbooks for Part 1** (26-2151, $3.50 each) are available.

Part 1: Videotape Lessons (26-2753, $349) is a series of ten 30-minute lessons based on Part 1: Introduction to BASIC. Requires the Part 1 student workbook.

Part 2: BASIC Programming (26-2152, $260) builds on the concepts introduced in Part 1. **Additional Student Workbooks for Part 2** (26-2153, $4.50 each) are available.

Part 3: Advanced BASIC (26-2154, $260) introduces the INKEY$ statement, ASCII character set, action graphics and more. **Additional Student Workbooks for Part 3** (26-2155, $4.50 each) are available.

Part 4: TRSDOS (26-2156, $299) covers concepts of the TRSDOS operating system. **Additional Student Workbooks for Part 4** (26-2157, $4.50 each) are available.

Introduction to TRS-80 Level II BASIC (26-2116, $9.95) is a beginning BASIC textbook for secondary students.

NOTE: Software not included in the above series. Student activities are designed for hands-on experience with Level II or Model III BASIC (or TRSDOS in Part 4).

Learn Machine Language

The **Illustrated Computer** (26-2670, $44.95) introduces secondary students to machine language programming concepts using simplified machine language. Requires 32K Extended BASIC Color Computer with disk drive.

Network Pascal (26-2739, $799) is a new version of TRS-80 Pascal (26-2211) designed for use with Model III/4 and Network 3 in a classroom environment. Many new features including a combined editor/compiler. Model III or Model 4 disk system required. **Additional Student Manuals** (26-2740, $14.95).

Introduction to Pascal (26-2674, $350) is a complete, structured teaching package with teachers manual, overhead transparencies and 25 student workbooks. **Additional Student Workbooks** (26-2675, $7.95).

TRS-80 COBOL for Models II, 12, and 16, Vol. One (26-2706, $49.95) teaches fundamental concepts. Requires COBOL Development System (26-4703, $299) and a Model II, 12, or 16 computer. Use it as a self-teaching tool, or with **Class Notes** (26-2723, $9.95).

Computer Literacy Packages

Computer Discovery™ introduces computers and basic programming concepts. Each includes interactive exercises, 25 workbooks, and instructor's manual. **Computer Discovery for Junior High** (26-2630, $189.95) requires a Model III or Model 4 disk system. **Additional Workbooks** (26-2631, $4.25 each). **Computer Discovery for Senior High** (26-2632, $189.95) requires a Model III or Model 4 disk system. **Additional Workbooks** (26-2636, $4.25 each).

Careers in Computing (26-2758, $130) includes teacher's guide, 30 student manuals, narrated filmstrip, eight spirit masters and wall chart. **Additional Student Manuals** (26-2759, $1 each).

Computer Literacy: Computers Past and Present (26-2755, $9.95) is designed for students in grades 4 through 8.

The **Computer Connection** (26-2663, $69) introduces basics of computer literacy to junior and senior high school students. Includes teacher's guide, spirit masters, four wall charts and narrated filmstrip.

Radio Shack and TRS-80 are #1 in the Classroom

Radio Shack is the leading marketer of microcomputers to schools, with more TRS-80 computers in America's schools than any other brand. And we maintain an extensive development effort to produce educational materials that use microcomputer technology in the best ways possible.

We offer educators a variety of special services. Our National Bid Department gives prompt attention to school bids. Our National Lease Department can put the TRS-80 into your classroom with terms that meet almost any budget. We offer "carry-in" and "on-site" service plans, too. And as an educator, you are eligible to attend our classes for educators without charge, at one of over 400 Radio Shack Computer Centers.

Radio Shack gives you complete support. We have 26 Regional Educational Coordinators located across the country. They can conduct demonstrations, workshops, and in-service training sessions for your school district. And our Regional Educational Coordinators can assist you in selecting the computer system and courseware that best suit your needs. For more information, visit your nearest Radio Shack Computer Center or participating store or dealer. Or call your Regional Educational Coordinator.

For the name of the full-time Regional Educational Coordinator in your area, call our Education Division at 800-433-5682, toll free. In Texas, call 800-772-8538.

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TRS-80 Shared Learning Systems

A **TRS-80 Network** lets you implement a shared learning system—connecting non-disk student stations to the teacher's disk, or "host" computer. Students can access programs with low-cost TRS-80 non-disk computers. The teacher can send programs to the student computers, and their work can be saved on the teacher's diskettes. An optional line printer attached to the host computer lets students get printouts of their programs. Your computer lab requires less duplicate courseware because several students share the same software. We also offer a variety of Network systems to meet your particular needs.

Radio Shack's **Network 2 Controller** (26-1211, $499) enables up to 16 non-disk student stations to be connected to the teacher's host computer using the cassette ports. The Network 2 Controller can be used with a Model III or Model 4 disk and non-disk computers; with Color Computer disk and non-disk systems; or with the Model 100 computer. Controllers can be cascaded to connect more stations. All cables are included.

The **Network 3 Controller** (26-1212, $599) enables up to 16 non-disk Model III or Model 4 student workstations (with RS-232C interfaces) to select and access lessons stored on the teacher's Model III or Model 4 disk system. Network 3 is designed for use with the educational software packages indicated in this catalog by an asterisk (*). Connecting cables available separately. Requires **Network 3 Operating Software** (26-2775, $149), or Network 3 Hard Disk Operating Software (26-2778, $149).

The **Network 4 Shared Learning System** adds flexibility and economy to your computer lab or classroom. Using a twisted-pair cable, the Network 4 lets you connect up to 63 non-disk Model III or Model 4 student stations to a central host computer with a hard disk drive. The student stations can then share hard disk files, each station operating virtually as a stand-alone system. Each user can quickly access a set of teacher-designated programs and data files from the hard disk. Information can be sent from station to station without using the hard disk and reports can be printed on a printer at the host computer. The Network 4 system requires a Model 4 host with a **Master Upgrade Kit** (26-1136, $299.95), a 15-megabyte hard disk (26-4155), **Network 4 Operating Software** (26-2773, $230), 64K Model 4 student stations (26-1058) and cables. Model III or Model 4 systems can be upgraded with a **Student Station Upgrade Kit** (26-1137, $299.95).

Our TRS-80 Education Management Systems

School Administrative Software Series

Interactive system to help schools collect, store, retrieve and print basic student information, attendance data, grades and scheduling information. Each program requires a TRS-80 Model 12 or Model 16 with two floppy disk drives (or one floppy drive and hard disk), or a Model II with one floppy drive and hard disk. A line printer is required to produce reports. All packages except the Student Information System require a Radio Shack CR-510 Card Reader plus the Student Information System.

The Student Information System (26-2729, $249) helps ease the burden of record-keeping. Easily collect, record, update, retrieve and distribute student data.

The **Attendance System** (26-2730, $330) helps keep track of attendance of students entered.

Attendance Cards (26-2741, $24.95 Pk. of 500).

Class Roster Forms (26-2744, $19.95 Pk. of 500).

Our **Grade Reporting System** (26-2731, $380) records and prints grades and more for each class.

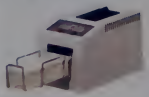
Report Card Forms (26-2745, $9.95 Pk.of 500).

Grade Cards (26-2742, $12.95 Pk. of 500).

The **Scheduling System** (26-2732, $290) helps plan and update school master schedules, anytime.

Course Request Cards (26-2743, $24.95 Pk. of 500).

Student Schedule Forms (26-2746, $9.95 Pk. of 500).



Automate data compilation, evaluate surveys and polls, or correct multiple choice tests with the **TRS-80 CR-510 Card Reader** (26-1266, $1595). It provides single, demand or continuous feed operation, reads marked or punched cards, and is controlled through manual switches or software. The CR-510 includes a diskette with COBOL and BASIC driver routines, and requires a TRS-80 computer with RS-232C port. Cables available separately.

Football Scouting Program

Store and analyze scouting information on your opponent's offense with **CHAMPS™** (26-2703, $149.95). Designed for high school and college levels, CHAMPS provides various charts and statistical reports. Includes ten CHAMPS Scouting Manuals. **Additional Scouting Manuals** (26-2708, package of 10 for $39.95) are available. Requires a Model III or Model 4 disk system and a 132-column printer.

REKORD Planner is a quick access data management system adaptable to your own needs. A program and tutorial diskette, plus sample formats are included. Choose from **Administrator's Version** (26-2725, $499), **Counselor's Version** (26-2726, $499) and **Special Programs Version** (26-2727, $499). A Model III or 4 disk system is required.

Colorful Programming Languages For Learning

Our **Color LOGO** helps students grasp fundamental programming concepts. Through manipulation of a "turtle" on the screen, students learn to program and gain valuable insight into advanced mathematical, geometric and logical concepts. In addition, Color LOGO is versatile. Children under reading age can use Color LOGO's "doodle" mode to create their own graphics using one-key commands. For older children, Color LOGO features a "hatch" command which allows creation of multiple turtles that are capable of running separate programs simultaneously. Our **Disk Color LOGO** (26-2721, $99) requires a 32K Extended BASIC Color Computer and disk drive. The **Program Pak™ Color LOGO** (26-2722, $49.95) requires a Standard BASIC Color Computer. Use your own TV with either version.

Our **Color LOGO Teacher's Book** (26-2761, $3.95) gives you instructional ideas and activities for presenting LOGO in the classroom.

The **Color LOGO Parent's Book** (26-2763, $3.95) is designed for parents and kids to learn LOGO together.

Color LOGO Lab (26-2770, $199) provides a complete guide for teaching Color LOGO. **Additional Student Workbooks** (26-2771, $2 each) are available.

Our SUPER LOGO is an expanded version of Color LOGO. You get all the features of Color LOGO plus list processing capabilities, decimal arithmetic and more flexibility in the immediate use mode. **Disk SUPER LOGO** (26-2716, $99) requires a 32K Extended BASIC Color Computer and disk drive. The **Program Pak SUPER LOGO** (26-2717, $49.95) requires a Standard BASIC Color Computer. Use your own TV with either. **SUPER LOGO** (26-2738, $299) is compatible with Network 2.

DR Logo offers beginners and advanced students a powerful way to draw pictures, create intricate graphics designs, play word games, chart figures and more. Features include split screen debugging, list processing capabilities, on-line help and upper and lower case characters. An easy-to-follow tutorial lets first-time users begin writing programs quickly. Model III or Model 4 **DR Logo** (26-2781, $99.95) requires 64K. Tandy 2000 **DR Logo** (26-2782, $125) requires 256K, high-resolution monitor recommended. Model 1000 **DR Logo** (26-2783, $125) requires 256K.

Radio Shack Makes Courseware Development Easy

Our authoring systems make it easy to create courseware. No programming knowledge is required. Each program requires a Model III or Model 4 disk system.

TRS-80 AUTHOR I (26-1727, $149.95) is a screen-oriented authoring system. Sample lesson included.

TRS-80 AUTHOR I Lesson Presentation Package (26-2707, $64.95) presents lessons created using TRS-80 AUTHOR I. (Not required if you have TRS-80 AUTHOR I).

Courseware Development with AUTHOR I (26-2697, $350) helps educators design their own lessons.
Courseware Development Student Manual (26-2698, $4.95).

TRS-80 Network 3 AUTHOR I Lesson Presentation Package (26-2713, $299) allows the Network 3 Controller to present lessons created with TRS-80 AUTHOR I. Requires host computer with two disk drives.

TRS-80 MicroPILOT™ (26-2718, $119.95) is a command-oriented language that lets you create your own courseware or adapt it from any curriculum suitable for computer assisted instruction. Based on the PILOT computer language, but offers extended graphics and handling capabilities. Requires a Model III or Model 4 disk system.

Color PILOT lets you mix text and high-resolution graphics. It features a line editor and easy one-letter commands. **Disk Color PILOT** (26-2710, $79.95) requires an Extended BASIC Color Computer with disk drive. **Tape Color PILOT** (26-2709, $59.95) requires a Standard BASIC Color Computer. Use your own TV with either.

Quick Quiz: A Mini-Authoring System (26-1728, $39.95) makes it easy to create, store, and give multiple-choice tests. Type up to 40 questions with four answer choices per question. Scores can be printed or stored on disk. Requires a Model III or Model 4 disk system.

Game Writer (26-2572, $44.95) is a unique programming language for creating programs that draw pictures, produce sounds and make shapes move about the screen. Requires a 32K Color Computer disk system.

Helpful TRS-80 Educational Resource Materials

The third edition of our **TRS-80 Educational Software Sourcebook** (26-2712, $9.95) is a complete guide for educational courseware for TRS-80 computers. It contains over 1800 vendor-furnished listings of programs classified under 14 subject areas. Each listing gives program content, grade level, instructional technique used, and hardware required. Many contain user-site references. Also includes publisher profiles.

My TRS-80 Likes Me (26-2751, $2.50) is a teacher's guide to helping elementary students understand BASIC.

The **TRS-80 Microcomputer Information Handbook for Educators** (26-2757, $2.50) describes what microcomputers and courseware are, and how they can be used.

Radio Shack's Proposal Writing Guide (26-2754, $9.95) is a guide for educators who want to write proposals for funding from an outside source for computer-related education projects.

Number Patterns (26-2752, $2.50) shows how to introduce sequences and series using computers.

Notebook Machine Features Full-Size LCD

Data General/One

The DG-1, the first entry by minicomputer manufacturer Data General into the world of microcomputing, is a 10 lb. notebook portable that outperforms all but the mightiest desktop machines. The system sports a full-screen liquid crystal display of 80 columns x 25 lines in the text mode. This, along with 128K RAM and a single built-in disk drive, is very competitively priced at $2895 list.

This new model is the first personal computer to incorporate an LCD capable of displaying text and graphics with the resolution and in the exact proportions of a conventional computer terminal screen. In bit-mapped display, resolution is 640 x 256 pixels, and graphics capability is standard. The unit sports a 79-key, full-size, full-stroke, Selectric-style keyboard. It has rudimentary diagnostics, telecommunications, and text editing programs in ROM, and a clock/calendar. Dual serial ports are standard.

Built around a CMOS 80C88 processor, the unit runs industry standard operating systems such as MS-DOS, CPM-86, and Venix (an AT&T licensed implementation of Unix), and is claimed by Data General to be fully compatible with the IBM PC. As usual, we offer our standard caveat: a potential buyer should make sure that the software he wants to run will in fact run on any compatible, *before* a purchasing decision is made.

The DG-1 can be fitted with up to 512K of RAM and two 3.5" double-sided microfloppy drives of 737K each. In addition, an optional external 5.25" IBM compatible drive makes thousands of existing applications programs available. DG is planning to offer a PC-compatible expansion chassis for its new portable, providing users with additional features such as color and monochrome terminal support, memory expansion, hard disk capability, and bus space for up to five full-size expansion cards.

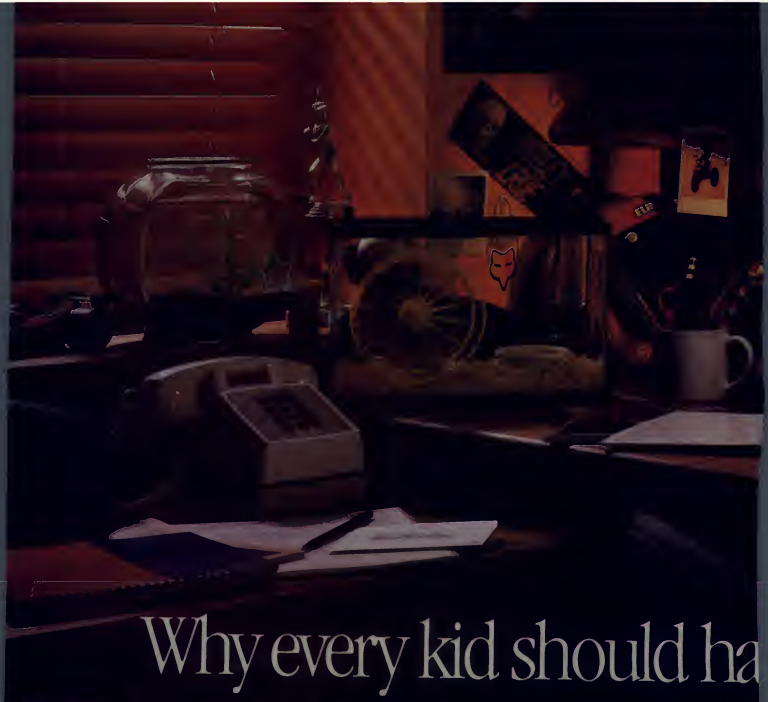
Also offered as options are an internal 300 baud modem, rechargable nicad battery pack, and external 1200 baud modem. DG also plans to offer a $500 portable thermal printer, capable of 40 cps on roll or single sheet paper. It weighs 4 lbs., measures 3" x 12" x 4", and can be powered by AC or batteries.

Designed and developed jointly by a team of engineers from Data General's Japanese subsidiary, Nippon Data General, and U.S. engineers, the DG-1 is manufactured on a specially designed automated assembly line near Tokyo. The unique LCD screen is manufactured by Epson.

We will provide a definitive review of the product in an upcoming issue.

Data General Corporation, 4400 Computer Dr., Westboro, MA, 01580, (617) 366-8911. ■

CIRCLE **402** ON READER SERVICE CARD



Why every kid should ha

Today, there are more Apples in schools than any other computer.

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Of course, since the IIc is the legitimate offspring of the IIe, it can access the world's largest library of educational software. Everything from Stickybear Shapes™ for preschoolers to SAT test preparation programs for college hopefuls.

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For example, 3-in-1 integrated business software. Home accounting and tax programs. Diet and fitness programs.

Not to mention fun programs for the whole family. Like "Genetic Mapping" and

With a IIc, your kid can do something constructive after school. Like learn to write stories. Or learn to fly. Or even learn something slightly more advanced. Like multivariable calculus.

ve an Apple after school.

"Enzyme Kinetics."

And the Apple IIc comes complete with everything you need to start computing in one box.

Including a free 4-diskette course to teach you how—when your kids get tired of your questions.

An RF modulator that can turn almost any TV into a monitor.

As well as a long list of built-in features that would add about $800 to the cost of a smaller-minded computer.

128K of internal memory—twice the power of the average office computer.

A built-in disk drive that would drive up the price of a less-senior machine.

And built-in electronics for adding accessories like a printer, a modem, an AppleMouse or an extra disk drive when the time comes.

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As soon as they get home from school.

** The FTC is concerned about price fixing. So this is only a Suggested Retail Price. You can pay more if you really want to.* © *1984 Apple Computer Inc. Apple and the Apple logo are registered trademarks of Apple Computer Inc. Wyleheat Shapes is a trademark of Optimum Resource. For an authorized Apple dealer nearest you call* **(800) 538-9696.** *In Canada, call* **(800) 268-7796** *or* **(800) 268-7637.**

The First Aussie Micro

Dulmont Magnum

Come to think of it, the Australians should have a halfway decent chance of designing and marketing a microcomputer. What with the proximity to the suppliers of the Far East, the raw materials are there. Because English is spoken (after a fashion), there isn't much of a language barrier with the rest of the English-speaking world. And Australia has been actively interested in the field of microcomputing for quite some time. One might be less surprised by the recent appearance of an Australian computer than by the fact that it has taken this long for one to appear at all.

What is rather surprising about the first Aussie micro is that it is a notebook portable. The Dulmont Magnum is about the size and weight of the Hewlett Packard Portable, and packs much of its punch.

The Magnum combines a 16-bit Intel 80186 processor with 96K of RAM, and word processor, spreadsheet, telecommunications, file manager, and appointment programs burned into ROM. It also features dual 128K ROM cartridge slots.

Opening the hinged flip-top lid of the Dulmont machine reveals a full-size half-stroke keyboard and an easy-to-read 80-column x 8-line LCD. The Magnum comes standard with a rechargeable ni-cad battery pack, good for about twelve hours of continuous use. A small lithium battery keeps RAM contents intact and runs the clock when the computer is not in use. An AC adapter is also supplied standard.

One might be less surprised by the recent appearance of an Australian computer than by the fact that it has taken this long for one to appear at all.

Photographs by Jeff MacWrathi

The Keyboard

The 76-Key Selectric-style keyboard sports 12 function keys and a Help key. Cursor keys are laid out to the left and right of the spacebar, and take some getting use to. The Return key is oversized and hard to miss.

Most keys have an automatic repeat feature, so if you press the key for more than half a second, it will repeat at a rate of ten characters per second. There is a "keyclick" option, to provide greater feedback to those who desire it.

Like the HP Portable, the Magnum keyboard cannot be called a full-stroke. Full depression of a key occurs within a depth of 0.25". Still, touch-typing is quite possible, and with a little bit of practice I'm sure you would no longer notice the difference.

Slightly more uncomfortable is the rake of the keyboard itself, which in order to accommodate the fold-in screen, is actually angled slightly *away* from the user. Again, given some time with the

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When we introduced Pitstop, we created action in the pits. Now, with PITSTOP II, EPYX introduces true competitive auto racing, both on the track and in the pits. Auto racing is not a one man sport. With PITSTOP II, you can now experience the thrill of speed and competition as you battle your opponent in a race against the clock. Now, more than ever, the strategy of when you make a pit stop and your pit crew's speed and performance, combined with your skill on the track, will determine the winner.

A split screen shows you your position and that of your opponent, a digital clock displays time and a lap counter gives you your race position as you race against each other in pursuit of the checkered flag. You can also play against the computer and take a practice lap or race against the computer controlled pace car as you prepare for real head-to-head competition. Step up to PITSTOP II because auto racing is not a solo sport.

One or two players: joystick controlled.

EPYX™ COMPUTER SOFTWARE

Strategy Games for the Action-Game Player

CIRCLE 141 ON READER SERVICE CARD

machine, this no longer seems a major consideration—merely an idiosyncrasy.

The Screen Display

Again showing a similarity to the HP, the Dulmont offers a key combination to adjust LCD contrast. I had no problem reading the screen display of the Magnum, and in fact found it to be slightly easier to read than the HP. Then again, with an LCD only half the size of that on the I 10 (8 lines as opposed to 16), legibility is understandably improved.

The lid angle itself is, of course, adjustable, and a lever on the top of the keyboard selects the point at which the opened screen will rest. This avoids the problem of having the screen flop down unexpectedly.

Unlike the HP, the Dulmont Magnum can power an external CRT, and futhermore, requires no additional

Magwriter is a full-featured word processor with sufficient capability to handle either a quick memo on the move or a lengthy document.

equipment to do so, as do the Tandy Model 100 and NEC 8201. This is probably the outstanding feature of the unit.

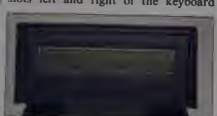
The Dulmont comes standard with the following connector ports: parallel I/O, dual serial I/O, video, and a bus expansion port. This expansion port can be used to connect to disk drives, or external RAM expandable to 256K.

ROM Onboard

The Magnum has 128K of internal ROM, in which the bundled software packages appear. This chunk of code is accessed by the unit as drive A. Drive B and C correspond to the ROM cartridge slots left and right of the keyboard proper. Drive D corresponds to internal CMOS memory. If external drives are attached, they are accessed as drives E and F. Let's take a closer look now at drive A.

Magwriter is a full-featured word processor with sufficient capability to handle either a quick memo on the move or prepare a lengthy document. It is designed for ease of use; you can get by with a small subset of its capabilities, learning more only as your needs expand.

Some of the features of *Magwriter* are the following: full screen display with arrow keys used for cursor movement; "undo" facility to allow for correction of editing foul-ups; ability to read *WordStar files* and accept many *WordStar* commands, print to screen, disk file, or printer (or all simultaneously); print line may be up to 250 characters long; full top, bottom, left, and right margin control; support of headers and footers; automatic page numbering; mail merge capability; and ability to read other files into workspace, write portions of a workspace into other files, obtain a directory listing, and delete files from within *Magwriter*.



HARDWARE PROFILE

Name: Dulmont Magnum **Type:** Portable Microcomputer **CPU:** 16-bit Intel 80186 **RAM:** 96K, expandable externally to 256K **ROM:** word processing, spreadsheet, terminal, file, diary/appointment manager **Operating System:** MS-DOS **Keyboard:** 76-key half-stroke, Selectric-style **Display Resolution:** 80 x 8 lines text **Ports:** Parallel port, dual serial ports, video, expansian bus. **Dimensions/wt:** 12" x 11" x 2", 8.5 lbs **Documentation:** Adequate. Executed on the machine itself. **Summary:** A respectable first entry from Australia. **Price:** $2215

Distributor: Teleram Communications Corp.
2 Corporate Park Dr.
White Plains, NY 10604
(914)694-9270

Magcalc

Magcalc is a full-function spreadsheet program, allowing you to build complex models. As with *Magwriter*, it is designed for ease of use. Menu-driven operation enables you to learn it very quickly.

A summary of *Magcalc* features follows: 250 x 250 cells; rows, columns and cells may be named, and these names used in formulae to ease readability; absolute, relative, and indirect addressing for cells in formulae; variable precision calculation (specify significant digits to speed calc time); cells may be displayed as dollars, normal, fixed, exponential, graph, and default; rows and columns can be "locked" in place on the screen while the rest of the spreadsheet is scrolled; the screen can be split either horizontally or vertically, allowing "window" capability; hierarchical protection, with global enable/disable; portion or whole of spreadsheet can be printed to screen, disk, or printer.

Magterm et al.

Magterm provides sophisticated communication capabilities via the serial ports which allow the Magnum to be

IMPOSSIBLE MISSION.
YOUR MISSION–TO SAVE THE WORLD.

As a member of the exclusive Anti-Computer Terrorist Squad (ACT), your mission is to find and reach the infamous Elvin, who is holding the world's population hostage under threat of nuclear annihilation. You must negotiate a path through the rooms and tunnels of his headquarters trying to avoid Elvin's robot protectors.

Should you try to outrun or jump over the next robot or play it safe and take the time to assemble the codes needed to deactivate the robots and then to find and stop Elvin.

Use your camera to photograph as many clues as possible to find the password which will allow you to penetrate Elvin's control room.

Your Mission—To Save The World, But Hurry!

One player; joystick controlled.

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CIRCLE 176 ON READER SERVICE CARD

Dulmont Magnum (continued)

used for terminal emulation or transferring files between machines. *Magterm* allows for up to 9600 baud operation, with X-on/X-off protocol, terminal emulation, file transfer, and chat modes.

Address/Phone Book maintains a file of names, addresses, and telephone numbers. The file can be edited using the word processor and then searched for an arbitrary string: first or last name, area code, and so on. The program operates on a text file, similar to the address program in the Model 100. While it should not be confused with an actual database program, it is useful and simple to work with.

Diary combines an electronic clock/calendar with a diary system that allows you to make and edit diary entries for any day. The diary file can be edited by the word processor as well. In addition to your "home" time, the planner will display the time in four other time zones around the world.

The Magnum is MS-DOS compatible, and you can transport programs from your desktop machine via serial port.

Compatibility

The Magnum is MS-DOS compatible, and you can transport programs from your desktop machine via serial port. We did not try it, but a serial to serial cable is included in the basic package.

Our standard warning is issued for this as for all MS-DOS "compatible" machines: make sure the specific program you want to run will run on a compatible *before* you buy it. Not all compatibles run all MS-DOS programs. Bear in mind also that the 8-line display of the Dulmont LCD is bound to affect the use of many desktop programs.

The Kicker

The two ROM cartridge slots and external video are the major selling points of the Dulmont. A relatively small display and relatively large pricetag are its weak points. As portables go, the Dulmont holds its own, and certainly its designers from down under should be proud of their debut in the micro industry. Should you buy one? Well, if you're shopping for a portable, why not at least have a look? ■

CIRCLE **403** ON READER SERVICE CARD

WELCOME TO APSHAI. YOU'RE JUST IN TIME FOR LUNCH.

Boy, have you taken a wrong turn. One moment you're gathering treasure and the next you're being eyed like a side of beef.

You're in the Gateway to Apshai.™ The new cartridge version of the Computer Game of the Year,* Temple of Apshai.™

Gateway has eight levels. And over 400 dark, nasty chambers to explore. And because it's joystick controlled, you'll have to move faster than ever.

But first you'll have to consider your strategy.

Is it treasure you're after? Or glory? You'll live longer if you're greedy, but slaying monsters racks up a higher score.

The Apshai series is the standard by which all other adventure games are judged. And novices will not survive.

They'll be eaten.

One player; Temple of Apshai, disk/cassette; Gateway to Apshai, cartridge, joystick control.

EPYX
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STRATEGY GAMES FOR THE ACTION-GAME PLAYER.

CIRCLE 128 ON READER SERVICE CARD

*Game Manufacturers Association, 1983

A Delightful Writing/Organizational Tool

Framework

I am going to start this review on an unusual note by reviewing the reviews of *Framework*. I have read six or seven of them to date, and they all rail against the product for various and sundry reasons. One reviewer whines that the program designers force the user to accept a particular human interface (a "desktop metaphor").

The reviewer goes on to state that an application program's metaphor should be user-customizable. This is, I think, hard lines on a programmer. For example, what if a user's effective working metaphor is tossing memos out of a Fokker during a World War II dogfight? Is the programmer responsible for providing details of the cockpit, or merely supplying bare metal and a blowtorch?

In any case, with all the complaints, silly or otherwise, regarding *Framework*, not one of the reviews cites what I consider to be the biggest problem with the product (I'll put all the negative stuff up front). Let me state right here that the Framework desktop metaphor is elegantly implemented and fit my hand like an exquisitely designed Parisian glove. Regardless of all the attention paid to human design, however, *Framework* did not run properly on any of the three IBM computers I have at my disposal: (a) an early vintage PC, (b) a PC with an IBM expansion chassis, and (c) a PC/AT. In effect, having gone to considerable lengths to design, package, and advertise this interface, the company proceeded to manufacture it in exactly one size, and woe betide users who deviate. Ashton-Tate claims to have fixes for (a) and (c); folks with (b) are on their own. It is nice that fixes are being provided on a timely basis, but given the fastidious nature of *Framework*, I would be nervous about adding anything to a working configuration, lest my $800 program cease to function.

Framework is based on the concept of "frames," each of which can hold outlines, spreadsheets, databases, or other frames.

Part of the sensitivity problem appears to be their execrable copy protection scheme, which requires a *Framework* System disk be present in drive A when the program is started. I find this to be such an annoyance that, if the program weren't so outstanding, I would toss it into the corner with Other Exasperating Programs I Have Known. Ashton-Tate is said to be working on an alternative method of copy protection which I hope will cause the allergenic tendencies of *Framework* to evaporate.

To describe *Framework* in a sentence: it is a writing/organizational tool that is a delight to use. With a few caveats, it is beautifully documented and speedy. As mentioned somewhat obliquely above, the human interface is superb. Despite the weight of two volumes of documentation and five disks, an hour or so will suffice to orient you to the basic command structure. There are few keystrokes to memorize, and these are well assigned. I found the on-line help to be more than adequate in most cases, and every command is accompanied by meaningful prompts. It is difficult to get lost or confused inside *Framework*.

The Package

The package contains five disks: a main system disk with one backup, a secondary system disk, a utilities disk, and a tutorial disk. The tutorial is well done and is particularly impressive in light of the fact that it was written in Fred, the *Framework* programming language. *Framework* requires a minimum of 384K to run effectively and, although you can operate with floppy disk drives, a fixed disk is very convenient.

The utilities disk contains several auxilliary programs not mentioned in the manual which, having been written in Fred, demonstrate the power of this programming language. Programs are provided to convert *WordStar* document files, *VisiCalc* DIF files, and *Lotus 1-2-3* files (this last program is a regulation .COM file). Also included is a mailmerge program for printing customized form letters and mailing labels and a clever program for composing music.

If your machine has an 8087, *Framework* will sense it and use it. Addition, subtraction, multiplication, and division however, do not benefit from the

SOFTWARE PROFILE

Name: Framework **Type:** Integrated database/word processing/spreadsheet/communications package **System:** IBM PC **Format:** Double sided disk **Summary:** Outstanding idea processor **Price:** $695
Manufacturer: Ashton-Tate
10150 West Jefferson Blvd.
Culver City, CA 90230
(213) 558-0086

TIRED OF WAITING FOREVER FOR YOUR PROGRAMS TO LOAD?

INTRODUCING THE FAST LOAD CARTRIDGE FROM EPYX.

You're tired of waiting forever for your Commodore 64 programs to load. But it's no use glaring at your disk drive. Calling it names won't help, either. It was born slow – a lumbering hippo. You need the FAST LOAD CARTRIDGE from EPYX. FAST LOAD transforms your Commodore 64 disk drive from a lumbering hippo into a leaping gazelle. With FAST LOAD, programs that once took minutes to load are booted up in a matter of seconds.

FAST LOAD can load, save and copy your disks five times faster than normal. It plugs into the cartridge port of your Commodore 64 and goes to work automatically, loading your disks with ease. And that's only the beginning. You can copy a single file, copy the whole disk, send disk commands, and even list directories without erasing programs stored in memory.

And unlike other products, the FAST LOAD CARTRIDGE works with most programs, even copy protected ones, including the most popular computer games.

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Speed them up with FAST LOAD!

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CIRCLE 127 ON READER SERVICE CARD

Framework (continued)

additional hardware. The manual says that most other functions will realize greater execution speed.

The Concept of Frames

Framework is based on the concept of "frames," each of which can hold outlines, spreadsheets, databases, or other frames. A simple example is shown in Figure 1a. This is a bare *Framework* outline shown in "outline view." Each of the numbers corresponds to a frame which can be expanded to display its contents. If frame 1 is expanded on the screen, it will be shown to contain frames 1.1, 1.2 and 1.3. The letter E that follows some of the frames indicates that that frame is empty. Figure 1b shows the same outline after some entries have been made in the frames.

A document can also be viewed in "frames mode" by pressing F10. In this case as many frames as will fit are contained on the screen. The frames can be sized and dragged according to your whim (see Figure 2).

The screen is organized as a "desktop." The lower righthand corner of the desk is reserved for the "trays." This is where the document is placed when not in use. A file can be removed from the tray and opened by moving the highlighted cursor to the desired choice and pressing Return. Conversely, closing the file is accomplished by positioning the cursor on the outermost frame of the document and hitting Return. There are no restrictions on the number of open files; just as in real life, your desk can imitate a jumble sale, or it can be a model of orderliness.

Just as in real life, your desk can imitate a jumble sale, or it can be a model of orderliness.

The top line of the screen has a menu line accessed by pressing Ins and navigated with the cursor keys. The advanced user can bypass this sequence by pressing the Ctrl key and the first letter of the desired option. When a menu item is selected, a frame opens and displays the choices available. The chosen function can be executed either with the highlighted menu bar, followed by Return, or by typing the first letter.

For example, the Create option offers you the choice of creating an outline, an empty frame, a spreadsheet, a database, rows/records, or columns/fields. The width and height of the latter two can also be sized from within this menu option.

The function keys are assigned to the most commonly used functions such as Help, Zoom (enlarge a frame to full screen), Edit Formula, Recalc, Extended Select, Move, Copy, and Size and Drag (frames). Another file on the utility disk, MACLIB.FW, contains 15 macros for other often-used command sequences, such as date, time, split frame in two, and record a macro. Ten of these are assigned to the Alt-function keys.

With a few exceptions, I found the key assignments sensible and intuitive; a seasoned user can really make the keyboard smoke during an intensive *Framework* session. I don't happen to like the choice of the Ins key to access the command menu, but I rarely use it anyway, preferring the speedier Ctrl key access.

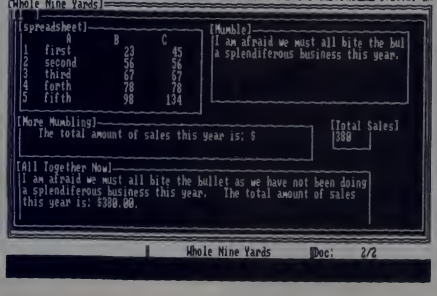
Figure 1a. Bare outline.

```
1
    1.1   (E)
    1.2   (E)
    1.3   (E)
2
    2.1   (E)
    2.2   (E)
    2.3   (E)
3
    3.1   (E)
    3.2   (E)
    3.3   (E)
```

Figure 1b. Partially clothed outline.

```
1  Introduction
     1.1  metaphors (W)
     1.2  negatives (W)
     1.3  positives (E)
2  Word Processor
     2.1  cursor movement (E)
     2.2  functions (W)
     2.3  (E)
3  Spreadsheet
     3.1  words (W)
     3.2  sample spreadsheet (S)
     3.3  (E)
     3.4  (E)
```

Figure 2. Frames view.


Ins Create Edit Organize Frames Move Windows Options Print 6:20.13 am
[Whole Nine Yards]
[Spreadsheet]
A B C
1 first 23 45
2 second 56 56
3 third 67 67
4 forth 78 78
5 fifth 98 134
[Mumble]
I am afraid we must all bite the bul
a splendiferous business this year.
[More Mumbling]
The total amount of sales this year is: $
[Total Sales]
380
[All Together Now]
I am afraid we must all bite the bullet as we have not been doing
a splendiferous business this year. The total amount of sales
this year is: $380.00.
Whole Nine Yards Doc: 2/2

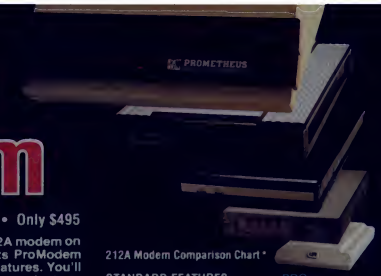
Documentation

Two hefty volumes comprise the documentation: one is an extensive tutorial and the second, a reference manual. Although it is handsomely bound and printed, it could use some improvement. In particular, short shrift is given to advanced facilities such as macros and the highly touted Fred programming language. If you want to take advantage of Fred, you will have to either spend hours experimenting or wait for the avalanche of books that is sure to appear.

Ashton-Tate claims that Fred and other advanced features, were deliberately left out of the manual so as not to confuse the novice user. This is silly; novices often mature into experts, and programmers who want to develop applications with Fred will also be purchasing the program.

Given the high cost of *Framework*,

Top Modem



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- ProCom Software

212A Modem Comparison Chart *

STANDARD FEATURES	PRO	HAYES STACK	NOVATION SMARTCAT++	ANCHOR 1200	US ROBOTICS PASSWORD
300/1200 Baud (212A)	✓	✓	✓	✓	✓
Intelligent Microprocessor	✓	✓	✓	✓	✓
Tone and Pulse Dialing	✓	✓	✓	✓	✓
Hayes Command Compatible (Works with Smartcom™)	✓	✓	✓		
Additional telephone jack with exclusion switching	✓	✓	✓		
Analog loop back self test	✓	✓			
Self Test at Power Up	✓	✓	✓		
Call Progress Detection (Busy, Dial Tones, Trunk Busy, etc.)	✓	✓	✓		
Speaker and External Volume Control	✓	✓	✓		
Full Complement of Status Lights	✓	✓			
8 Switch Selectable power-up defaults	✓	✓			
Adaptive Dialing	✓	✓	✓		
Auto Redial on Busy	✓	✓	✓		
Ergonomically designed easy to read front display panel	✓				
Internal Stand-Alone Power Supply	✓				
Built In Real Time Clock/Calendar	✓				
Help Command	✓				
300 baud connect while maintaining 1200 baud RS-232 link	✓				

EXPANDABLE OPTIONS
Automatic Receiver Buffer
Automatic Transmit Buffer
On-board Personal/Business Directory
Buffer, Expandable to 64K
Auto Logon Macros
Auto message transmission to groups of numbers
Records call duration
12-character Alphanumeric Display

CIRCLE 195 ON READER SERVICE CARD

ZORK
I

ZORK
II

ZORK
III

A LOCKED DOOR. A DEAD MAN.
DEADLINE

WITNESS

SUSPICION

AND NOW FOR SOMETHING INCOMPLETELY DIFFERENT!

Incomplete, yes.
But it's not just because we're always bringing out new stories in the Infocom interactive fiction collection. Nor is it simply due to the fact that with all the writing and re-writing, honing and perfecting that we put into every one of our stories, our work is seemingly never done.

The real reason is: an Infocom work of fiction can never be complete until you become a part of it.

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In SUSPECT,™ our newest mystery thriller, you're a reporter who gets the scoop on the society event of the year—the murder of a Maryland Blue Blood at a fancy costume ball. Great! Except you're the prime suspect. And if you can't find the real killer, your next by-line could be in the obituaries.

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*Use the IBM PC version for your Compaq, and the MS-DOS 2.0 version for your Wang or Mindset.

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CIRCLE 114 ON READER SERVICE CARD

it is outrageous to require an additional expenditure for a Fred Programmer's Manual. Furthermore, almost everyone who has had some exposure to integrated packages wants a simple, easily implemented (and documented) macro facility. The explanation of macros in the manual is confusing and certainly inadequate for the beginner, who will most likely want to simplify complex command sequences by using macros.

User-defined Fred functions are placed in libraries; when invoked from a program, *Framework* will search the desktop for a file with a .LIB extension. One such library is provided on the utilities disk.

Word Processor

The word processor is not fancy, but it is more than adequate for letters and short to medium length articles. I found it pleasant and unobtrusive. It has an excellent range of cursor movement and can right/left justify and center text. Left and right margins can be selected with the Words menu option, and the Print menu offers several other choices. A wide range of formatting functions is available; these are constructed as formulas and embedded in the frame border. For example, the formula:

```
@hc("Framework Review"),
    @fl("10/2/84")
```

sets up a centered header and a left justified footer. Because these formulas can be placed only in frame borders, to change formats in the middle of a document requires that you set up a subframe containing the appropriate new formatting command.

Several of the word processing features, like typeover mode and search/replace, can be accessed only through menu line options. This didn't bother me because I always use insert mode anyway and rarely search text. Some may find the access to these features awkward. With the color graphics adapter, the high-resolution graphics screen is used and text designated as bold, underlined, and italic shows up as exactly that. On a monochrome screen, however, italic text is underlined.

Spreadsheet

The spreadsheet, like the outlining feature, encourages modularity by defaulting to a small size. You can, of course, enlarge the spreadsheet at will, to a maximum of 32,000 by 32,000 cells, but the amount of RAM is the real limiting factor; a 5000 cell spreadsheet requires about 256K. Because spreadsheets can be linked conveniently, it is often more sensible, especially in view of the recalculation speed (see below), to set up two smaller sheets rather than one large one.

Cells can hold numbers, formulas, or text and can be referred to by position (e.g., B2) or by name (e.g., Expenses.1984). Cell width is adjustable. Information can be hidden by placing it in a zero-width cell; hidden data does not print. Text and numbers can be styled with the Words menu for bold, underlined, and italic. Seven different number formats are available in the Numbers menu.

Numbers from a spreadsheet can be inserted directly into a spreadsheet or database frame, but not into a Words frame. I find this a curious omission, because most people using integrated packages want to be able to sprinkle spreadsheet data in a textual explanation. There are a few ways around this problem, however. The spreadsheet can be saved as an ASCII file and then manipulated at will. Alternatively, a separate frame can be set up with a concatenation formula (see Figure 2). The containing frame, Whole Nine Yards, holds a spreadsheet, two segments of text (Mumble and More Mumbling), and a calculated value (Total Sales). The All Together Now frame contains a formula that concatenates Mumble, More Mumbling, and Total Sales. If a value in the spreadsheet is altered, the change is reflected in both Total Sales and All Together Now.

The word processor is not fancy, but it is more than adequate for letters and short to medium length artides.

There are some features that I wish were available. The spreadsheet cursor cannot be set for automatic advancement; it takes two keystrokes to advance the cursor. Curiously, there does not seem to be any way to move directly to a specific cell. This isn't too serious with small spreadsheets, but as the size of the spreadsheet increases, so does the time spent banging on the cursor keys.

Database

The single-file database facility isn't very sophisticated, but suffices for sim-

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CIRCLE 169 ON READER SERVICE CARD

ple applications. Not surprisingly, *dBase II* and *dBase III* files are compatible with *Framework*, and transfer facilities are provided for converting between them. Although *dBase II* and *dBase III* files can be loaded directly into *Framework*, they undergo considerable expansion when converted: each byte of a *dBase* file occupies about ten bytes of *Framework* memory.

A database, like an outline or a spreadsheet is created with the Create option on the main menu line. The screen can be shown in "table view," which is the database version of the zoomed (F9) frame. Fields are listed at the top of the form, with each record occupying one line underneath. Alternatively, the "forms view" (F10) can be used to display fields inside individual frames; they can be dragged and sized just like regular word frames. Fields, like cells, can hold text or formulas. The latter can reference either fields or spreadsheet cells.

Records can be sorted on one field, and the database can be searched with a user-defined filter formula specified in the frame border. A filtered database hides records which do not conform to the formula. The hidden frames can be "opened" again by invoking the "open all" function from the Frames option on the menu line. Sorting is done entirely in memory and is very fast.

Graphing

The graphing facility is impressive in both speed and ease of use. Data to be graphed are selected with a function key, and the graph type chosen from the Graph options menu. You have a choice of bar, stacked bar, pie, line, X-Y, exploded pie, and marked points. A graph can be linked to a spreadsheet or a database, sized, dragged, and, of course, printed. While a graph cannot be placed directly into text, it is fairly easy to fake it by designing the layout in frames view (Figure 3), printing the text, backing up the printer, and printing the graph (Figure 4). The entire procedure can be assigned to a macro.

The telecommunications module, MITE/MS, is loaded as an optional utility. It is entirely menu-driven and looked easy to use. Unfortunately, I was unable to test it because of installation problems (see below).

Summary

Framework is not quite bug-free. While the access to DOS, and the ability to run other programs as child processes

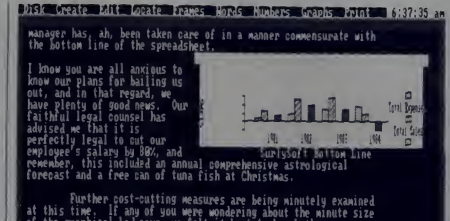
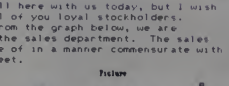

Disk Create Edit Create Frames Words Numbers Graphs Print 6:37:35 am
manager has, ah, been taken care of in a manner commensurate with the bottom line of the spreadsheet.
I know you are all anxious to know our plans for bailing us out, and in that regard, we have plenty of good news. Our faithful legal counsel has advised me that it is perfectly legal to cut our employee's salary by 80%, and remember, this included an annual comprehensive astrological forecast and a free can of tuna fish at Christmas.
Total Expenses
Total Sales
1981 1982 1983 1984
SurlySoft Bottom Line
Further cost-cutting measures are being minutely examined at this time. If any of you were wondering about the minute size of the graphical bad news, we felt it best to break the news slowly. If any of you really want to feel crummy, turn to page 3 of this report.
[Annual Report.Picture
C:\Fw\Graph\SurlySoft Bldg\ Annual Report.Picture Frame: 3/4

Figure 3. Designing Layout in frames view.

I am happy to have you all here with us today, but I wish I had more cheerful news for all of you loyal stockholders. Unfortunately, as can be seen from the graph below, we are definitely not up to snuff in the sales department. The sales manager has, ah, been taken care of in a manner commensurate with the bottom line of the spreadsheet.



I know you are all anxious to know our plans for bailing us out, and in that regard, we have plenty of good news. Our faithful legal counsel has advised me that it is perfectly legal to cut our employee's salary by 80%, and eliminate our heretofore generous benefit package. If you will remember, this included an annual comprehensive astrological forecast and a free can of tuna fish at Christmas.

Further cost-cutting measures are being minutely examined at this time. If any of you were wondering about the minute size of the graphical bad news, we felt it best to break the news slowly. If any of you really want to feel crummy, turn to page 3

Figure 4. Text and graph.

is convenient, it doesn't always work correctly. *Word Perfect*, for example, runs fine as a child. When control is returned to DOS, however, the machine locks up and requires a cold reboot. During installation of the telecommunications module, the program did something odd to the Prolocked disk, such that the program was no longer recognizable as a legitimate copy and refused to load. I was thus left with one backup disk and a mild cold sweat lest something happen to it before a replacement arrived. I was also able to crash the program occasionally while loading the macro library MACLIB.FW.

The word "fun" is rarely used in conjunction with a serious applications package, but there is no denying that it is applicable to *Framework*. The design is slick, the response rapid, and the potential enormous for vertical, customized applications. I found the frame concept easy to absorb, and the flexibility it offers in the area of idea processing has had a remarkable effect on my ability to produce a document. Serious spreadsheet and database users, however, may find *Framework* too limited for their needs. ■

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The Archon Dragon

What does this mean? Is it a good thing? And why, in light of this, did the people pictured here decide to issue a scorching sequel named *Archon II: ADEPT*?

For starters, we don't really know what it means. Except that a lot of people who had a pretty good time with *Archon* are about to get more of what they like. And people who've yet to experience the best-selling, award-winning, knuckle-whitening original have *two* good things coming their way.

The Archon Basilisk

Point two: If there's a moral issue here, we see it this way: A wise man once said, "I ain't never had too much fun." We agree. And we think that once you get your hands on *Archon II: ADEPT*, you'll see his point.

Now for the third question. Why a sequel? Well, there are sequels and there are sequels. The good ones happen because people just haven't had enough of a good thing. Obviously we're here to tell you that *Archon II: ADEPT* falls into the right category.

The ADEPT Chimera

Where Archon took inspiration from chess, fantasy role-playing characters and arcade combat, *ADEPT* comes more from a world of its own making. Like *Archon*, it pits the forces of good against those of evil. But in place of the chessboard motif there is a map of elements—Earth, Air, Fire and Water. The role of magic is greater. The strategies are deeper. Things move faster. And the hidden algorithms that control the computer's play are considerably smarter.

The ADEPT Thunderbird

Having already spent the better part of a month playing *ADEPT* (in order to write this ad, of course), we're quite confident it will seduce you too.

And if, by some strange chance, there is a parallel universe in which computer simulations come to life, we are confident that a large part of its population has Jon Freeman, Paul Reiche III and Anne Westfall to thank for their brief and miserable existence.

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MACHINE REQUIREMENTS *Archon* is available on the Apple II, II+, IIe & IIc. IBM-PC, PCXT & PCjr, Commodore 64 and Atari. *Archon II: ADEPT* is available on the Commodore 64 and Atari.

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CorrectStar

State-of-the-Art Spelling Checker

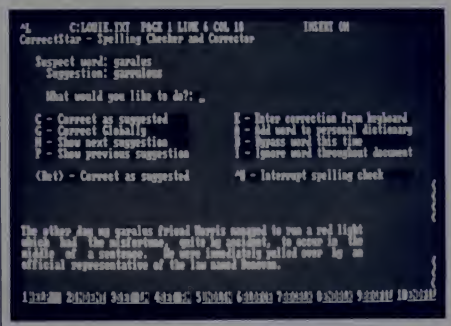
CorrectStar, a spelling checker, is the latest addition to the MicroPro family of "Star" software. It works with the *WordStar* word processor, *MailMerge* file merger, and *StarIndex* index creator.

CorrectStar uses a 65,000-word main dictionary based on the American Heritage Dictionary published by Houghton Mifflin. MicroPro boasts that *CorrectStar* contains 99.2 percent of the most frequently used words in the English language. For speed, a 9000-word subset of the main dictionary loads into RAM.

Of course, some words, especially industry-specific terms, are included in that .8 percent not contained in the main dictionary. Not to worry. *CorrectStar* allows you to create a 1500-word personal dictionary.

Like other spelling checkers, *CorrectStar* flags misspelled words. However, *CorrectStar* also offers alternative spellings based on phonetic and linguistic algorithms developed by a research team uner Henry Kucera of Brown University.

CorrectStar uses a menu-driven format. Your options include: replace a word with the suggested alternative spelling, show another alternative spelling, enter a correction from the keyboard, bypass the misspelled word, and add the word to the personal dictionary. The section of text containing the misspelled word is displayed at the bottom


C:LAWLIE.TXT PAGE 1 LINE 4 COL 10 INSERT ON
CorrectStar - Spelling Checker and Corrector
Suspect word: garulos
Suggestion: garulous
What would you like to do?
C - Correct as suggested
G - Correct Globally
N - Show next suggestion
P - Show previous suggestion
E - Enter correction from keyboard
A - Add word to personal dictionary
B - Bypass word this time
I - Ignore word throughout document
(Ret) - Correct as suggested
^I - Interrupt spelling check
The other day my garulos friend Harris managed to run a red light
while [illegible] the California, quite by accident, to occur in the
middle of a sentence. My eyes immediately pulled over by an
official representative of the law named Dawson.

SOFTWARE PROFILE

Name: CorrectStar **Type:** Spelling checker **Author:** Morris Jones **System:** 192K IBM PC, Tandy Model 2000, DEC Rainbow, TI Professional Two 320K disk drives **Format:** Disk **Language:** C and assembly **Summary:** Intelligent program suggests alternative spellings. **Price:** $195; $85 to SpellStar owners **Manufacturer:** MicroPro International Corp.
33 San Pablo Ave.
San Rafael, CA 94903
(415) 499-1200

State-of-the-Art Spelling Checker (continued)

of the screen so you see where the word is used and in what context.

Loading in the sample text, we were amazed by the efficiency and ease of finding and changing misspelled words and typos. "Afishal" became official, "garrulus" became garrulous, and a host of common and not-so-common words were inserted in place of the misspelled words.

Of course, *CorrectStar* performs flawlessly with a sample provided by MicroPro, but does it work with actual day-to-day writing? How about a different sample with simple, but premeditated, gaffs, goofs, and good old fashioned typos?

In tests, *CorrectStar* scanned tens of thousands of bytes of documents and flagged every misspelled word quickly.

CorrectStar flags every word that is misspelled and even some that are not.

Unique words were quickly entered into the personal dictionary, and alternative suggestions took care of the rest.

Next, we gave it an especially torturous sample. We deliberately kept the words simple and included some words that were spelled correctly but used incorrectly. The first alternative spelling displayed, whether it was right or not, was accepted. The result appears as Figure 1.

Plusses

CorrectStar flags every error and generally offers a correct alternative. It is fast, complete, and very easy to use. It includes a word counter, soft hyphens, and on-screen help.

One especially handy feature is the automatic reformat. If you make a spelling change that either increases or decreases line length, the program automatically reformats the paragraph and presents you with a ready-to-print *WordStar* file.

A Minus

CorrectStar requires two disk drives, one for the main dictionary, and the other for the file. Unless you have a third disk drive for *WordStar*, you must either pull out the *WordStar* disk and insert the *CorrectStar* disk, or have your file on the *WordStar* disk itself. It takes only a few seconds to switch disks, but if you intend to check many files, this can be a nuisance.

If you own a hard disk, you do not need to worry about switching disks, and there is little to prevent you from enjoying an advanced spelling checker.

```
    Wunce upon a tyme, persunal compewters ewre nuthin but a
dreame of sients fikshun righters. Shure, the Unighted States
Goverment predickted the entire kuntry woul need twelve
amneframes. Thenn sum upstart company called IBM cawsed a stirr
by predicting the ned for fifty. Well, the yeers past, and yu no
whot happend? The flegling industrie proliffrayted, and Creeative
Compewting write a long with it. And what is the most populer
program? Werd processsing. And what may becum the second most
pipular? Misspelling chekrs. Heres the laytist offereng from
MicroPro, CorrectStar.
```

Figure 1a. A paragraph as typed by one of our less literate staffers.

```
    Whence upon a time, personal computers were nuthin but a
dreams of silents fiction fighters. Share, the United States
Government predicted the entire country wool need twelve
amneframes. Then sum upstart company called IBM caused a
stair by predicting the end for fifty. Well, the years past,
and yea no hot happens? The fledgling industries
proliferated, and Creative Competing write a long with it.
And what is the most popular program? Word processing. And
what may became the second most popular? Misspelling
checkers. Herds the latest offering from MicroPro,
CorrectStar.
```

Figure 1b. The paragraph as corrected by CorrectStar.

And In Between

CorrectStar flags every word that is misspelled and even some that are not. For example, in this article, it flagged "misspelled," "bypass," and "incorrectly" as well as names, including its own. Most of the time, *CorrectStar* provides an alternative spelling, although the program seems at a loss for words when confronted by a name. MicroPro boasts that *CorrectStar* suggests the single, most likely word 80 percent of the time. As our sample shows, this is a reasonably accurate statement.

One last point. *CorrectStar* is a spelling checker, not a usage checker. It does not distinguish between "passed" and "past" or "sum" and "some". If the word is spelled correctly, the program will not flag it, even if it is used incorrectly.

CorrectStar is an intelligent spelling checker. It flags the misspellings and typos, offers workable alternatives, comes packed with features, and operates from *WordStar*. *CorrectStar* should be a welcome addition to your *WordStar* word processing system. ■

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A Sidetrip To The Sciences

Growing Up Literate

Cell Defense? Invertebrate biology? Plant biology? In a series on language arts software? Good grief! The woman has taken leave of her senses. Well, perhaps, but we prefer to think of this month's departure from the norm as a change of pace. It also gives us a chance to cover some packages that don't fit into any of our regular education features. So don your lab coat and let's get going.

Cell Defense

The cover of the *Cell Defense* package features a very unSpock-like Leonard Nimoy clad in a dark business suit inviting you to "explore the endless possibilities waiting for you in the world of science." Since we have sworn off language arts for the month, we will refrain from commenting on the meaninglessness of that sentence and move swiftly to the inside of the plastic binder where we find the disk and the documentation.

Documentation

The documentation booklet is cleverly presented in the form of a science notebook. It has the familiar black and white marbled design on the cover, and inside, the "notes" that help you play the game are handwritten on lined pages.

Most of the space in the notebook is devoted to explanations of the various parts of the immune system. The types of cells with which you will be dealing in the game are described, as are the different defenses you can use against the invading viruses. Colorful sketches of cells and symbols decorate the margins and help you learn what to look for on the screen.

What the booklet does not do very well is tell you how to play the game. Having seen a very confusing demonstration of the program at a recent show, we were particularly careful to read the documentation thoroughly before trying to play the game. Even so, we lost quite a few patients before we caught on to the mechanics of play.

Game Play

Cell Defense is a biology simulation in which you take control of different parts of the immune system and defend your cells against attack by evil, marauding viruses. You begin by specifying on a scale of 1 to 8 the number of cell layers, the virus infection rate, the cell regrowth rate, and the health of your organism. This is done with the joystick, and a click of the button starts the game.

At the left of the play screen you then see the outline of a human figure and, below it, a stylized representation of one cell layer. You use the joystick to move among the layers, and a flashing cursor tells you which of the cells in the layer is represented in the larger portion of the screen to the right.

As you move about in the cell layer, different cells occupy the screen; some of these are healthy and others are being attacked by viruses. Some of the defenses can be used to protect healthy cells, while others must be used aggressively against the viruses. Macrophages, for example, are handy for attacking loose

SOFTWARE PROFILE

Name: Cell Defense **Type:** Educational game **Author:** Sheldon White **System:** Commodore 64, Apple, IBM PC; joystick **Summary:** Challenging educational simulation **Price:** $29.95-$34.95

Manufacturer: Human Engineered Software
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viruses. If you see one on your screen, you can pick it up by moving the cursor over it and pressing the button. Then, if you come across a virus about to attack a healthy cell, you can, by passing the macrophage over it, destroy the virus. In reality, what usually happens is that you find a cell inhabited by the maximum number of viruses, and realizing that that cell is about to self-destruct, you wait until it explodes, setting the viruses free, and then gobble them up before they can do any further damage. Meanwhile, of course, damage is occurring in other cells and in other layers.

The different kinds of cells that compose each layer vary in "value"; you can lose 59% of your labile cells and remain alive, but a loss of 40% of your perennial cells spells death.

As the game continues, both your progress in defending the organism and the progress of the viruses in debilitating it are represented graphically on the layer diagram at the left of the screen. As

We suspect that the understanding you acquire from playing Cell Defense will stay with you long after the conclusion of the next biology test.

cells are destroyed, the outline of the organism fills up until either the critical number of destroyed cells is reached or the viruses are brought under control. Your success or failure duly noted, the program returns quickly to the opening screen, and you are given a chance to play again.

Play on all but the lowest levels is frenzied and stressful. We found ourselves physically exhausted after about an hour of play. As in life, you must be able to concentrate on more than one activity or event at a time, and you must be able to make decisions quickly.

Summary

Once we got the hang of it, we enjoyed *Cell Defense*. It has an addictive quality that makes you want to keep on playing, varying the difficulty level and testing new strategies as you become adept at saving the organism. The variety of difficulty levels makes it suitable for a wide range of ages, but only one person can play at a time.

So, it is fun. But is it educational? That depends on your definition of education. If your objective is to memorize the names and functions of the components of the immune system, you could probably accomplish that several times over with flash cards in the amount of time it would take you just to learn how to play *Cell Defense*.

If, however, you want to learn not only their names and functions but how they interact and what their interactions mean to the organisms they inhabit, *Cell Defense* will stand you in good stead. We also suspect that the understanding you acquire from playing cell defense will stay with you long after the conclusion of the next biology test.

On the negative side, the information to be learned is somewhat limited. If you happen to want to learn exactly the material covered by the simulation, *Cell Defense* is just what the doctor ordered. If you happen to need or want a different combination of facts, there is no way to modify or expand the program to make it more useful.

As an introduction to the workings of the immune system, *Cell Defense* is excellent. As an entertaining and challenging game, it also gets high marks. We just wish that the documentation were more specific in its description of the mechanics of game play.

CIRCLE **406** ON READER SERVICE CARD

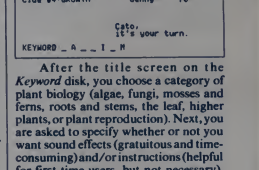
MicroFocus Keyword Series

We enjoyed reviewing the *Micro-Focus Keyword* biology series. Dredging words like *deliquescent* and *sporangiophore* up from cold storage in our brains afforded us the same sort of satisfaction we get from playing Trivial Pursuit—the satisfaction of finally being rewarded publicly for learning a bit of information we thought we would never need after the final exam was turned in.

One of our young playtesters who was in the throes of learning some of the botany terms in school felt similarly rewarded for her efforts. A second, who was in the same situation, thought that the whole thing was too much like work.

Format

The biology series consists of keywords from vertebrate biology, invertebrate biology, plant biology, and human systems. We shall limit our discussion here to the plant biology disk, but the other programs in the series as well as programs that deal with the physical sciences (matter, energy, astronomy, and rocks and minerals) work in exactly the same way and have very similar documentation.



After the title screen on the *Keyword* disk, you choose a category of plant biology (algae, fungi, mosses and ferns, roots and stems, the leaf, higher plants, or plant reproduction). Next, you are asked to specify whether or not you want sound effects (gratuitous and time-consuming) and/or instructions (helpful for first-time users, but not necessary). You must then tell the computer how many people (one, two, or three) will be playing and enter their names. The high score for the topic you have chosen is displayed, and play begins.

Each player starts with 100 points. On the first turn of the round, the screen displays one clue and a series of dashes

SOFTWARE PROFILE

Name: MicroFocus Biology Keyword series, Vertebrate Biology, Invertebrate Biology, Plant Biology, Human Systems **Author:** Frederick Burggraf **System:** Apple II, TRS-80 Model 3 and 4 **Format:** Disk **Summary:** No-frills vocabulary builder **Price:** $39 **Manufacturer:** Focus Media, Inc.
839 Stewart Ave.
Garden City, NY 11530
(800)645-8989
(516)794-8900

representing letters in the keyword. If the first player cannot type the correct word, he can press the spacebar for another clue, and if he still cannot guess correctly, play passes to the next player.

A typical round might begin with 10 blanks at the bottom of the screen and "years" displayed as clue #1. As the game progresses, the words "many," "lily," "tree," and "grass" appear as clues, and at some point we deduce that the keyword is "perennial."

For each clue (including letters in the blanks) requested, the player loses a specified number of points depending on the length of the keyword (10 for a short word, 8 or 9 for a longer one). If he makes an incorrect guess or spells the keyword wrong while guessing, he loses half of his points.

After each round (keyword identified), players are asked if they want to continue. Assuming that they don't elect to quit, play continues until one player's point total reaches zero or all the keywords in the category are identified. If the winner's score is the highest to date, it is recorded on disk.

The number of keywords in each category varies between nine and 12, a fact that may limit the usefulness of the program. Barry Kasven, speaking for Focus Media, told us that the keywords were taken from the most popular science curricula currently being used in U.S. schools, but we found the number just a bit too small. After the second or third time through a category, players could identify most words on the first or second clue, simply because they recognized the combination of the first few clues and the length of the word.

Documentation

The documentation booklet is an 8 ½" x 11" typewritten "Lesson Planner." In the introduction, vocabulary building, spelling, patterning, and abstract thinking are offered as objectives. Kasven noted that slower students usually benefit from the program primarily through learning the spelling and definitions of the words. More advanced students, he said, enjoy the deductive reasoning process that is required to achieve a high score.

Also included in the booklet are very complete instructions for loading the program and a description of game play and rules. While not exactly a professional job graphically or typographically, the manual is quite adequate.

Summary

The *MicroFocus Keyword* series is clearly designed for classroom use, and is undoubtedly best suited for that environment. There is no reason it could not be used in the home, except that one or two students would soon master all the words on the disk and retire it — perhaps before squeezing $39 worth of good from it.

This entire series falls into our recently defined category of "no-frills drill and practice." The program offers neither tutorial material nor inspiring graphics. The simple game format does, however, provide sufficient motivation to keep students involved.

For enrichment, remediation, or review in the classroom, the *MicroFocus Keyword* series is a good choice. ■

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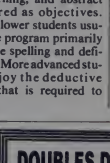

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Getting Organized with the Mac

If a computer is only as good as the software that runs on it, we are only just now getting a chance to determine how good Apple's Macintosh is. *Habadex* from Haba Systems and *ThinkTank* from Living Videotext are two recent additions to the Mac software library, and if the quality of these programs is any indication, the Mac is a good machine after all.

Habadex

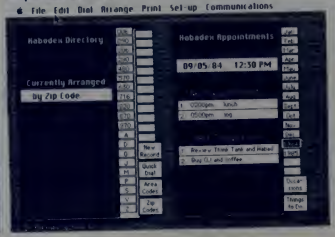
At first glance, *Habadex* appears to be an electronic Rolodex. It is, in fact, much more than that. According to its makers, it is a "powerful information and time management program." Well, yes, it is an information and time management tool (a phone book, calendar, and database); but powerful? *Habadex* turns out to be the perfect program by which to judge the Mac since its power derives from those characteristics that take advantage of the Mac's unique design and its weakness stems from the very same source.

On a superficial (which is not to say unimportant) level, *Habadex* is easily accessible. When you open the program, you see an address book and a date book—the kind with little tabs you press on to open it to letters of the alphabet or, in the case of the date book, to months. Like most good Mac software, most of

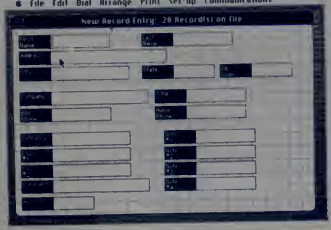
SOFTWARE PROFILE

Product: Habadex **Author:** Gary Crandoll **Type:** Database & Calendar **System:** Macintosh **Format/Language:** Disk **Price:** $99.95 **Summary:** This electronic Rolodex is a handy, flexible database but moves slowly if there is a lot of data.
Manufacturer: Haba Systems, Inc.
15154 Stagg St.
Van Nuys, CA 91405
(815) 901-8828

Sample Habadex Screen.



Sample Blank Record.



what needs explanation is explained on the screen, with symbols on the desktop itself or in one of the pull-down menus. (Oddly enough, the way to select something for cutting or pasting—one of the most basic functions on the Mac—is not self-evident. It is not done by pointing and dragging as in other programs, but rather by triple clicking.)

On a less superficial level, though, *Habadex* requires a great deal of foresight to be used effectively. The way in which you enter information directly determines how useful the program will be for you, but until you have put in some data, it is difficult to tell what the best way is.

One of the areas in which the power of Habadex is very clear is in the creation of labels and lists.

More important than that is the fact that the more data you enter, the slower the program moves. With five records in place, you can whip around the program, changing things here and there; with 25 records, you begin to wish that you had put the info in right the first time.

Directory

There are five basic parts to the program: the directory, the calendar, the Things To Do/Occasions section, the label/list/letter section, and the dialer. The directory is the centerpiece of the program. It holds most of the information used for the main functions. Information is contained in individual records, each of which is made up of 19 fields. To enter data, you click the mouse on the New Record tab of the directory to open up a blank record. The Tab Key (not the Enter or the Return key as I would have expected) moves you from field to field.

When you finish a record, you must save it by choosing Accept from the File menu or by pressing Command-A. Otherwise, when you try to close, a dialogue box warns you that you are about to lose the information you have just entered. I found this whole procedure to be somewhat counterintuitive also. It would make much more sense, I believe, to have included a little Accept/Cancel box at the bottom of the record.

The 19 fields can be arranged on the screen however you like and can be rearranged and renamed at will.

Of course, it is precisely this ability to customize that creates the problem I mentioned earlier. On the one hand, you don't want to waste time entering information you will end up changing, but until you have entered some, it is hard to have a feel for how you want to organize your information. I suggest that you enter one of each kind of record you expect to have, then play around with them.

For example, I put in a few friends, a few publishers, a few software companies, and so on. This helped me determine if there were fields I hadn't used at all which could be used for other kinds of information and if changing the name of a field would help me remember what to put in it.

Once you have all the information entered, you can play with it. Records can be arranged in nine different ways: by last name, first name, company name, zip code, category, account code, miscellaneous #1 and miscellaneous #2. Zip and account codes sort numerically; everything else sorts alphabetically.

Calendar/Appointment Book

The second part of the program is the calendar and appointments book. On the right side of the desktop is the calendar with tabs for each month. To see a month, you simply click with the mouse on the month you want. Then you can click on a particular day to check on or enter your appointments for that day. The appointment list has three fields: time, glance, and comments. The time can be entered any number of ways (05:00p, 0500PM, etc.), but it must be entered in a legal way if you want *Habadex* to beep when it is time for your appointment.

The glance field is where you enter a very brief description (ten characters) of the appointment, which appears both on the top of the calendar—along with the time—when it is closed and in the monthly calendar. The comment area is where you can put a more detailed description of the appointment.

The Things To Do and Occasions tabs open up lists of just what they say they will. The Things To Do list is useful since it allows you to prioritize things with the first two appearing on the calendar top. Neither list is integrated with the rest of the program.

Labels and Lists

One of the areas in which the power of *Habadex* is very clear is in the creation of labels and lists. You can customize the format to your own size and shape labels as well as select the fields and their placement on the label. What makes this all so powerful is how easily it is done because it is all visual. If you know how you want your labels to look, it is a simple matter of placing the fields where you want them. If you don't, it becomes a matter of experimentation. The same holds true for printing lists of information.

Habadex also has a mail merge function to allow for form letters. While this is very handy, the function isn't quite as flexible as one might like. The letter can be no more than a page long and must be in only one point size and font. It can have no indentations, no tabs, and so on. In other words, it will look like a form letter. It works by taking a letter written in *MacWrite* or *Word* and copying it to the clipboard. You then choose the Mail Merge function and design the top of the letter. The program will pick up the letter from the clipboard.

The last part of the program is telephone dialing. Since I do not have the HabaDialer or a modem for my Mac, I can only tell you that it sounded as if Habadex was dialing the right numbers for me. Habadex is quite flexible about how you can enter the phone numbers—with dashes, spaces, etc. A comma will cause Habadex to pause for a second, so if, like me, you use MCI and need a long pause between the access code and the account code, you can insert some commas (though a pause is already built in).

Habadex isn't going to replace my Rolodex, but I'm certainly happy to have both.

All told, this is a good solid program that is easy to use and reasonably flexible. It does have two significant faults, though. First, it seems to run exponentially slower as more records are added. And second, it seems to be a case of more is less—that is, even though you can do much more with it than you can with a good old fashioned Rolodex, you can't just look something up in a hurry while you're working on something else. In other words, Habadex isn't going to replace my Rolodex, but I'm certainly happy to have both.

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ThinkTank

ThinkTank, from Living Videotext, is billed by its maker as "The First Idea Processor." I'm not sure about the "First" part, but, at least the "idea processor" part of the claim turns out to be accurate. Originally designed for the IBM PC, this is in many ways the ultimate computer program. It helps you do what computers are supposed to help you do: organize yourself, your thoughts, your work. On the Mac, it seems even better than ever since moving bits and pieces of information is so easy with the mouse. (On the other hand, due to memory constraints, the Mac version does not allow for paragraphing.)

ThinkTank is, in a word, an outlining program to help you organize your thoughts, whether for a presentation, an article, or simply for yourself. The idea is to get everything down on paper (so to speak), then organize it. In theory, you should never lose another idea because ThinkTank makes it so easy to write them all down, then worry later about what makes sense. In practice, it can be tricky to learn to use the program effectively. Old habits die hard, and those of us who still use a typewriter half the time—or even pencil and paper (gasp!)—have trained ourselves over the years to do a great deal of mental editing before committing anything to paper.

In theory, you should never lose another idea because ThinkTank makes it so easy to write them all down, then worry later about what makes sense.

You begin by simply typing in your first thought. When you finish it, you hit Return, and the program is ready for your second thought. If it strikes you as a subsidiary thought to the first one, you can indent it by dragging it to the right with the mouse or by pressing Command-R (Command-L moves items left). When you hit Return again, the text will begin at the same indentation, or level, as the previous thought. You can indent it further or pull it back out.

Unless it crosses your mind right away to move it one direction or another, you shouldn't do it. Leave it and get on to the next idea. Later you can come back and organize , move things around, cut things out. Just let the ideas flow. If you sit down and try to write an outline, it won't work.

Sounds too simple to actually be a program, doesn't it? Well, there is a little more to it than that. First, each item you write is marked with either a dash or a plus sign. Any item or thought with subitems has a plus sign; the rest have dashes. This is important because you can close up groups of sub-items under their item. Thus, if, for example, the first thing I write is Popsicles and under that I write Good Humor, FrozeFruit, and Homemade, each by itself, Popsicles would have a plus next to it and the other words would have dashes.

Then let's say I go back to the item Good Humor, select it (by clicking on it), hit Return (pushing the cursor down a line), hit Command-R (indenting the item) and write Toasted Almond. Good Humor would now have a plus sign next to it since it has a sub-item. If I now go back to Popsicles and double click on the word, it will close up the outline, leaving only the word Popsicles. If I double-click again, it will open up to the three sub-items, and I will see that Good Humor had another sub-item because it is marked with the plus sign.

Why is this so helpful? This last feature keeps your thoughts from crowding you too much and distracting you from whatever you want to focus on. You can leave open only as much of the outline as you want, and you don't have to worry that you are losing the rest of your outline.

Going back to the popsicles for a moment, let's say I'm still at Toasted Almond when it crosses my mind that cherry was another big flavor with me as a kid. I hit Return and add Cherry on the same level as Toasted Almond. Now I'm really cooking: I remember that FrozeFruit offers a cherry flavor too. I click FrozeFruit, hit Return, Command-R and type Cherry.

I step back for a moment and realize I have Cherry written under two headings. This is where the program becomes truly useful. It makes it easy for me to decide that the point I'm really trying to make has to do with what has happened to popsicle flavors over the years, so what I want to do is categorize them by flavor rather than by brandname. There is no reason to be lazy about it. A few moves to the left and right, a cut and paste here and there, and suddenly I'm making my point.

When you finish an outline, you can print it out by selecting the first heading. If you want to print only one section, you select that heading, and it will be printed along with any sub-items.

Transferring outlines to *MacWrite*—a good idea in theory since that allows you to fill out the outline—turns out to be somewhat clunky. The easiest way to accomplish this is to copy the entire document onto the clipboard, then paste it into a new *MacWrite* document. The potential problem with this is that *ThinkTank* can hold longer documents than *MacWrite* can, so if your outline is very long, you can't transfer it. Another option is to begin by opening up *MacWrite*, then select the *ThinkTank* document. It will open in *MacWrite*, though not in its original form: the indentations and dashes will appear as dots and the word "head." A simple translation program would take care of this.

Another problem with the program is the length limitation on each entry, or item. While I can see a benefit to being forced to make a point concisely, this is clearly a rationalization. It would be much better if you could go back and fill in paragraphs here and there as needed. (Rumor has it that there will be a new version for the 512K Mac.)

Complaints aside, I still find this a terrific program. I am very resistant to changing my ways, especially when I have to pay to do it—and frankly, I find the price tag on this program a little high for something whose value is so hard to pinpoint. But to the program's credit, it managed to convert me. I was dead set against it at the beginning, but after using it several times, I started to get a feel for it, and the next thing I knew I was singing its praises. ■

SOFTWARE PROFILE

Product: ThinkTank **Authors:** Peter Winer & Dave Winer **Type:** Outline processor **System:** Macintash **Format/Language:** Disk **Price:** $145 **Summary:** Extremely helpful in organizing thoughts and ideas once you learn to use it effectively.

Manufacturer: Living Video Text, Inc.
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Bank President offers entertainment and education to aspiring financiers

Bank President

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In *Bank President*, from Lewis Lee, you become the chief executive officer of a bank. As CEO, you run the bank rather than use it, making decisions on interest rates, advertising, and loans.

That in itself would be sufficient challenge, but the game offers much more. You choose from four different types of banks—Full service, Consumer, Business, and Turnaround. Each turn represents one quarter.

The game places you in a historical economic situation, adds up to nine other live or computer-controlled cut-throat competitors, and includes dividend-hungry stockholders. Salaries, buildings, Treasury bills, Federal funds, and, of course, taxes, must be taken into consideration. In short, all the major aspects of financial decision-making in the banking industry are presented for your fiduciary pleasure.

The Fast Track

All players start dead even. The interest rate for savings deposits is 4.65 percent; for six-month certificates of deposit, 8.14 percent; and for one-year time deposits, 7.30 percent. Meanwhile, consumer loans carry a 12.76 percent interest rate; commercial loans, 7.69 percent; and fixed rate real estate loans, 7.62 percent.

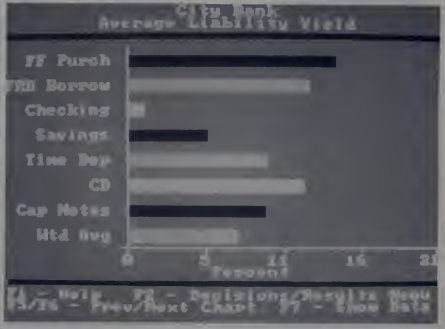
The information flows on—assets, in the form of loans, cash, securities, and premises; liability and equity, in deposits, Federal funds purchased and borrowed, and capital notes; income, based on interest revenue and expenses, advertising, salaries, and taxes; and the all-important bottom line, earnings per share, dividends, and stock price.

Furthermore, the economy fluctuates, so if you anticipate an upward or downward cycle and then act on it, you can reap great rewards. Likewise, if you fail to do so, your bank may fail. Meanwhile, your competitors are analyzing and acting on the same information, which affects your performance. And changes in the regulatory environment can upset even the best laid plans.

What's A CEO To Do?

This whirlwind of financial activity can overwhelm the most talented CEO. After all, this simulation mimics the real world—and quite well we might add. You will need help analyzing the information.

Before you reach for *Lotus 1-2-3*, know that *Bank President* contains more than 70 bar graphs, pie charts, and line graphs for each bank for each quarter.



SOFTWARE PROFILE

Name: Bank President **Type:** Business management game **Authors:** Dan Lewis and Winnie Lee **System:** IBM PC **Format:** Disk **Summary:** Outstanding simulation challenges your financial prowess. **Price:** $74.95

Manufacturer: Lewis Lee Corp.
P.O. Box 51831
Pala Alto, CA 94303
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Quite frankly, we gave only a cursory look at the graphs during game play. At one graph per screen, searching through all of them took too long, and by the time we reached the end, we had forgotten vital information we had seen at the beginning. We much preferred poring over a single sheet of printout on which all the pertinent information was compiled.

On each turn, you set the interest rates, decide how much to pay employees, figure out how much to advertise, issue stock, build new offices, and face the economic and regulatory environment.

As in the real world, all of these aspects are interrelated. As you play, you learn that different strategies result in different consequences. For example, increasing the interest rate for deposits brings in money to make loans. Advertising that fact brings in even more money. Lowering the interest rate for loans brings in customers. However, making too many loans at a low interest rate while paying depositors a high interest rate hurts the bottom line, which angers the stockholders.

More Than A Game

The 68-page instruction booklet details how to play the game. But *Bank President* is more than just a mental exercise in number juggling. It provides an education in the banking industry by discussing the fundamentals of banking and suggesting how various strategies apply to the game.

Bank President is more than just a mental exercise in number juggling. It provides an education in the banking industry.

You can use *Bank President* for classroom training. Indeed, a game of similar design already exists in certain management courses. *Bank President* takes advantage of the power of the computer to create an elaborate business setting.

While the program resides on a master disk, any number of students can use a data disk to review the results of the past quarter and make decisions for the current quarter. This way, students use several computers to play the game instead of crowding around one computer. When they hand in their disks, the teacher loads their decisions onto the master disk and then transfers the results back onto the data disk.

Our Bottom Line

Bank President is the first program in the Chief Executive Series, which will also include *High-Tech Entrepreneur* and *Venture Capitalist*. It combines entertainment, education, business graphics, and historical information into one of the best simulations of the business world that we've seen. Everyone who dreams of running his own financial institution—from mail clerk to MBA student to president—will enjoy the program. We give *Bank President* our highest rating. ■

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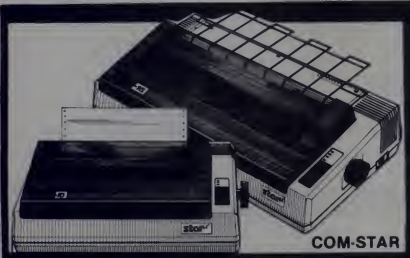

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This program will make your Apple II into a multitasking system

Teaching Your Computer To Juggle

It never fails. You spend three months creating your "Monster That Ate Cincinnati" game. Everyone loves it, but someone always asks, "Can't you put two monsters in there?" or three, or eighteen. But being the simple beast that it is, the actual processor can handle only one task at a time. It can go fast enough, however, to appear to be doing many things simultaneously. The multitasking system (don't let the word scare you) described here will let you program your computer to "juggle" several tasks at once.

Why is it necessary, or even desirable, to do such a thing? After all, many programs get away without multitasking, and it does tie up some computer time with overhead. What are the advantages?

Take, for example, the problem of adding another monster to munch on Cincinnati. With the "straight line" method of programming games, adding this new code is a great deal of boring work involving tables and pointers. The multitasking system (from now on, I'll call it a job system) makes it a ten-minute, one-reassembly job! Or how about adding printer spooling to that text editor you have been working on and never worrying about missing a keystroke or dropping a character.

Here's how it's done. First, let's take a look at the flow of a typical program. Structured programing, modularity, and the like aside, many programs *execute* in a long loop as shown in Figure 1. Notice I said *execute*; even though the program may make many detours, at one time or another it usually goes back to the top and starts over again.

As the program gets longer and more complex, it becomes difficult to understand. Errors can easily creep in,

Listing 1. Sample program to move a dot across the screen.

```
START:    initialize x,y

LOOP:     plot dot at x,y
          wait a while for player to see dot
          erase dot
          move dot
          goto LOOP
```

Listing 2. A not very efficient way of moving two dots across the screen.

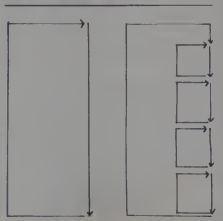
```
START:    initialize x(1),y(1)
          initialize x(2),y(2)

LOOP:     plot dot at x(1),y(1)
          wait a while for player to see dot
          erase dot at x(1),y(1)
          move dot at x(1),y(1)

          plot dot at x(2),y(2)
          wait a while for player to see dot
          erase dot at x(2),y(2)
          move dot at x(2),y(2)

          goto LOOP
```

Figure 1. Many programs execute in one long loop. (l) The multitasking system breaks a program into a series of smaller, connected loops. (r)



and the program loses its modularity and clarity. The job system can help this problem by breaking the long loop into a series of smaller connected loops.

For example, Listing 1 is an English language version of a program to move a dot across the screen. It is pretty straightforward. But what happens if we decide to move two dots? Well, the program in Listing 2 is one way to do it—probably not the best. It takes twice as much code and spends a great deal of time waiting around, not to mention how difficult it would be to add another dot. Another way is the program shown in Listing 3. The dot positions are arranged in an array, and the program steps through them one at a time, plotting each dot, waiting, erasing, and moving it. But it still wastes a lot of time.

What if we used that time to plot the other dots? With just a little rearrangement of Listing 3 you will have a program that wastes very little time. This program is shown in Listing 4. If you trace this program you will notice that it plots dot 1, then plots dot 2, then 3, and so on until all the dots (N) have been plotted. It then waits just once, instead of N times, for the dots to be seen. After the wait, the program erases, moves and plots dot 1, then dot 2 all over again.

Look at the subroutine WAIT. It doesn't really wait at all. It goes ahead and plots the next dot. Then, when all the dots have been plotted, it restarts at the top and does them all again. Also notice that the array index is changed each time. This is very important. The same little loop of code is actually doing N dots at once.

Big deal, you say, "anyone can write a program loop that works off an array." The important thing is that the loop executes with different data each time. Those data are kept separate from the other executions of the loop.

In fact, as long as the data are kept separate, it doesn't matter what kind of program loop is executed. You can have one program loop plotting dots, another checking the keyboard, another calculating pi, or whatever else you want.

For example, let's add to the data array used in Listing 4. In addition to the x and y coordinates, we'll also keep track of the program counter. Why? Because then you can leave off at any point in the program, return to the same place later on, and pick up where you left off. But in the meantime the processor can be off doing other tasks (hence the name multitasking).

Adding Different Program Loops

Now look at the program in Listing 5. Here we have added a second program loop. If, for example, you set N to 1 and jump to LEFTLOOP, you will get a dot moving to the left. If you then set N to 2 and jump to RITELOOP you will have a dot moving to the right *and* a dot moving to the left (the other loop is still running). Try it out.

You can have one dot going left and N-1 going right or three going right and N-3 going left. Or any combination you like. (You don't have to move dots with all the jobs. Instead of x and y, the data

Listing 3. A better way of moving more than one dot across the screen.

```
START:    initialize x(1),y(1) through x(n),y(n)

LOOP:     plot dot at x(n),y(n)
          wait a while for player to see dot
          erase dot at x(n),y(n)
          move dot at x(n),y(n)

          n = n + 1
          if n > maximum number of dots then n = 1

          goto LOOP
```

Listing 4. Listing 3 rearranged to wait only once for all the dots plotted.

```
START:    initialize x(1),y(1) through x(n),y(n)

LOOP:     plot dot at x(n),y(n)
          CALL WAIT
          erase dot at x(n),y(n)
          move dot at x(n),y(n)

          goto LOOP

WAIT:     n = n + 1
          if n > maximum number of dots then   return
               else
               wait for player to see all the dots
               n = 1
          return
```

Listing 5. Saving the program counter allows job loops to use the same data in different ways.

```
START:    initialize x(1),y(1) through x(n),y(n)
          n = 0
          CALL WAIT
          goto LEFTLOOP or RITELOOP depending on input

LEFTLOOP: get x,y from x (n),y(n)
          plot dot at x,y
          CALL WAIT
          get x,y from x(n),y(n)
          erase dot at x,y
          move dot at x,y LEFT
          store x,y at x(n),y(n)
          goto LEFTLOOP

RITELOOP: get x,y from x (n),y(n)
          plot dot at x,y
          CALL WAIT
          get x,y from x(n),y(n)
          erase dot at x,y
          move dot at x,y RIGHT
          store x,y at x(n),y(n)
          goto RITELOOP

WAIT:     store current program counter at PC(n)
          n = n + 1
          if n > maximum number of dots then
               program counter = PC(n)  ireturn to program

               else
               wait for player to see all the dots
               n = 1
               program counter = PC(1)  igo again with first dot
```

can be pointers, addresses, dates, or anything else.) The WAIT routine (some people like to call it a supervisor or a task manager) moves a pointer to the next block of data, extracts the previously saved program counter and jumps to it. The job loop then uses its own personal data from its data block.

All you have to do is write your program in small modular loops, and somewhere in the loop call the WAIT subroutine. WAIT will save your program counter, get the next data block, get the next program counter, execute from where that job loop left off, and return to you when all the other job loops have executed.

When a job loop finishes using a data block, it can release the block for some other job loop to use.

Design

Listing 6 illustrates a practical version of the job system for an Apple, although the principles can be used for any processor. Starting at the variable definitions, here is how it works.

If you look around line 34 of Listing 6, you will see a section called job data block equates. Our old friends PC, X, and Y are there along with some others (LO and HI are used to access 16-bit quantities 8-bits at a time). A status byte stands at the beginning of each block of data. Status is used mainly to determine whether its data block is in use or not. This way, when a job loop finishes using a data block, it can release the block for some other job loop to use. The job routines use only bit 0 of the status byte; all the others are free for the job loop to use for data.

The counter byte lets you skip execution of a job loop. For most jobs, the counter is set to 1, and they execute on every pass. But, if you have one job that is not very important or depends on some relatively infrequently changing data (say, the keyboard), just set the counter byte to 2, and it will be executed every other time through. Or set it to 8 to have it executed every eighth time.

These four bytes (PCLO, PCHI, STATUS, COUNTER) are the only ones necessary for the job routines to work properly. All the others are just data bytes, and you can add or delete them as you please. I have added some extra bytes to save the x and y positions, (XPOS, YPOS) and also the velocities (XVEL, YVEL) of the dots. These are not important to the functioning of the job subroutines. It is important that the length of job data block be correct. Put in or take out bytes as you will, but the routines use JOBLEN to determine the starting address of the next job data block. Figure 2 shows how the memory looks to the job system.

Notice also that the bytes in the job are defined as offsets. There are no absolute addresses here. Every time WAIT returns to a job loop, a variable called JOBPTR points to the top of its data block. The offsets are used to get data from the data block. JOBPTR + 0 points to the status byte; JOBPTR + 1 points to the low byte of the saved program counter; and so on. This allows the indirect indexed addressing mode of the 6502 to access the data. You just load register Y with the offset of the byte in the data block you need and LDA (JOBPTR), Y to get a byte or STA (JOBPTR), Y to store a byte in the data block.

If you wanted to increment the Y coordinate of some dot, it would go like this: Load the offset of the data block byte you want into register Y. Load the accumulator with the Y coordinate using indirect indexed addressing mode. Increment the accumulator and store it back in the same place using indirect indexed addressing again. It is quite simple once you get the hang of it.

Multitasking and the Real World

There are some things to watch out for when using a system like this.

1. The loop must call the WAIT subroutine somewhere. If the program loop branches to Guatemala or goes into an infinite loop, none of the other jobs will ever be executed.

2. Since there may be many users of one small piece of code, each job loop must have its own private variables. I usually just extend the data block until I have more than I can use (by making the

Figure 2. This is how the job data area looks to the job system.

Figure 3. GETJOB looks for a free data block.

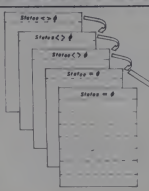


Figure 4. GETJOB initializes a data block.

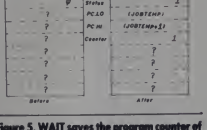
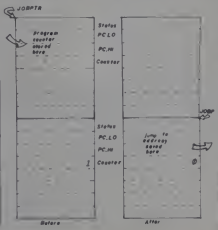


Figure 5. WAIT saves the program counter of the current job, finds the next active job, and resumes where the job left off.



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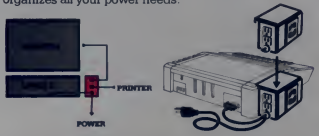

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equate JOBLEN bigger). This sometimes leads to inefficient memory usage.

3. While any job loop can use the stack as much as it pleases, no loop can *leave* anything on the stack (or in the registers, either) and expect it to be there when control returns after calling WAIT. Unfortunately, this means you can't call WAIT from a subroutine, as your return address won't be on the stack when you come back. (The routines could be written to include a stack for each job.)

The Routines

The following is a brief description of how the routines in the listing work.

INITJOB (line 265) is a simple routine that initializes all the job data blocks not used. It does this by zeroing the status byte of the data block. It is usually called before any jobs are used to make sure all the data blocks are free and to prevent job routines from using a data block that has garbage in it.

GETJOB (line 405) is the routine that finds the first unused data block in the data block area. It does this by starting at the top of the data block area and looking for a zero status byte (Figure 3). When it finds one, it marks the data block as used by setting the bit 0 of the status byte (all of the other bits are available to the user). It then stores the starting address of the job loop (passed in the two-byte variable JOBTEMP) in the job data block and sets the counter byte to 1 so the job will be executed next time through (Figure 4). The address of the data block is returned in JOBTEMP so the calling routine can initialize other parts of the data block if it wants to.

When your job has done its job and you want to stop it from ever executing again (when one of the space invaders gets shot by the player, for example) you simply call ZAP. ZAP zeroes the jobs status byte so it becomes a free data block, then executes the next job. Even though ZAP is called like a subroutine, it never returns to the caller.

If you want to stop all the jobs call ZAPALL. ZAPALL differs from INITJOB in that it zaps all the jobs *except the job that called it.* This is very convenient at times. When one of the space invaders shoots the player, for example, the player's job can call ZAPALL to stop all the space invaders' jobs. The player's job will still execute—to decrement his lives left or maybe start a new rack. (ZAPALL *does* return to the caller.)

All the job system routines call ER-

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Object Code Size (bytes)	128	255	329	181	415	
Program Load Time (secs.)	3.2	3.8	6.3	11.2	23.5	
Compile Time (secs.)	8.5	—	—	39	108	

As the benchmark results in the table show, PROMAL is much faster than any language tested. From 70% to 1000% faster! And it generates the most compact object code. The PROMAL compiler is so fast that it can compile a 100-line source program in 10 seconds or less. And, not only is it fast in compile and run time, it also reduces programming development time.

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ROR if there are problems. ERROR is an infinite loop that stops all the jobs from executing, making the program freeze. You can find the offending routine by looking at the top two bytes of stack. (The error that occurs most often is the "trying to run 21 job loops when there are only 20 job data blocks available" error.)

The WAIT (line 333) routine is the key to the whole system. This routine saves the program counter of the calling job, gets the next data block, retrieves the program counter from the new data block, and jumps to it. This is how it works. WAIT expects the number of passes to skip execution in the accumulator. The first thing it does is store this count in the job data block. It also expects the program counter on the stack. This is automatically done when WAIT is called as a subroutine. WAIT pulls the program counter off the stack and stores it in the job data block. This completes saving the state of the current job (Figure 5).

Now WAIT looks for the next active job data block. It does this by adding the length of the job data blocks (JOBLEN) to the address of the current job data block (JOBPTR). It then checks to see if this address is beyond the end of the job area. If it is, then it jumps to LASTJOB to reset the pointer to the beginning of the job area and starts again. If the job address is valid, WAIT checks to see if this job block is being used (status not equal to 0).

If the job data block is active, WAIT decrements the skip counter. If the skip counter is not zero (or the job is inactive) WAIT will go to NEXTJOB to try the next job data block in the list.

When the counter is 0, WAIT fetches the program counter of this job from the data block and pushes it onto the stack. It then does an RTS to jump to the job and start it running. We can't do a regular indirect jump here because of the way the 6502 handles subroutine calls. A 6502 indirect jump would land us one byte short of the place we wanted to go. Also using an RTS avoids the infamous 6502 indirect-jump-on-a-page-boundary bug.

Some Sample Jobs

Starting on line 75 Listing 6 shows an example of one way to use the job system. In the example, every time the Apple paddle 0 button is pressed a dot travels from left to right across the screen. Every time the paddle 1 button is pressed a dot travels the opposite way. Dots can be generated as fast as you can press the buttons—and remember each dot is a separate task. If you press the spacebar, the jobs will all be stopped by ZAPALL, and after a short delay, the screen will be erased.

Let's take a look at how it works. The whole thing begins at BEGIN (line 75). After some preliminary setup of the stack and clearing the screen, the program initializes all the job data blocks to zero with INITJOB. It then starts a job called FIREDOT and jumps to LASTJOB to start the job system running. FIREDOT checks the keyboard and the paddle buttons. If a key was pressed, it checks to see if it was the spacebar. If it was a space, it kills all the jobs (except itself, of course), waits a short time, (illustrating how to use WAIT to delay one job while the rest run unimpeded), clears the screen and resumes checking.

TRYFIRE checks to see if either paddle button has been pressed. Paddle button 0 causes a jump to FIRELEFT, paddle button 1 to FIRERIGHT. These segments are identical except for the velocities given to the dots. They also show how to pass parameters to job loops. BUTDOWN checks for the release of both paddle buttons before returning to the checking loop.

DOTPLOT and VELOCITY are just the implementations of the routines discussed before. They erase the dot, move it, plot it, and call the WAIT routine (actually NEXT, which just a WAIT 'til next time through).

So there you have it. Although the example shown is small, it illustrates a powerful tool you can use to make your programming job faster and easier. ■

Listing 6. One way to use the job system.

```
0003 0000                PRNT ON
0004 0000
0005 0000                TITLE 'MULTITASKING SYSTEM EQUATES'
0006 0000
0007 0000          JOBCOMMON DATA
0008 0000
0009 0000          ;-----------------------+
0010 0000          ;   HARDWARE EQUATES    +
0011 0000          ;-----------------------+
0012 0000
0013 0000          STACK  GEQU  $FF              ;INITIAL STACK POINTER
0014 0000          BUTTON0 GEQU $C061            ;PADDLE BUTTON INPUT ADDRESSES
0015 0000          BUTTON1 GEQU $C062
0016 0000          BUTTON2 GEQU $C063
0017 0000
0018 0000          KEY    GEQU  $C000            ;KEYBOARD DATA INPUT ADDRESS
0019 0000          CLRKEY GEQU  $C010            ;CLEAR KEYBOARD STROBE ADDRESS
0020 0000
0021 0000          SPCKEY GEQU  $A0              ;SPACE BAR KEY CODE
0022 0000
0023 0000
0024 0000          ;-----------------------+
0025 0000          ;   WORKING VARIABLES   +
0026 0000          ;-----------------------+
0027 0000
0028 0000          JOBPTR GEQU  $00              ;POINTER TO CURRENTLY EXECUTING JOB DATA BLOCK
0029 0000          JOBTEMP GEQU $02              ;TEMPORARY LOCATION FOR JOB ROUTINES
0030 0000
0031 0000
0032 0000          ;-----------------------------+
0033 0000          ;   JOB DATA BLOCK EQUATES    +
0034 0000          ;-----------------------------+
0035 0000
0036 0000          STATUS GEQU  0                ;STATUS: IN USE OR FREE
0037 0000          PCLO   GEQU  1                ;ADDRESS TO JUMP TO WHEN ACTIVE
0038 0000          PCHI   GEQU  2
0039 0000          COUNTER GEQU 3                ;NO. OF TIMES TO SKIP EXECUTION
0040 0000          XPOS   GEQU  4                ;X POSITION OF DOT
0041 0000          YPOS   GEQU  5                ;Y POSITION OF DOT
0042 0000          XVEL   GEQU  6                ;X VELOCITY OF DOT
0043 0000          YVEL   GEQU  7                ;Y VELOCITY OF DOT
0044 0000          JOBLEN GEQU  8                ;LENGTH (IN BYTES) OF EACH JOB DATA BLOCK
0045 0000
```

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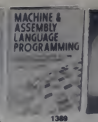

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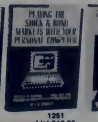

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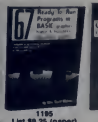

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```
0046  0000          NJOBS  EQU  5             ;NO. OF DATA BLOCKS AVAILABLE
0047  0000
0048  0000 000000    JOBAREA DS  JOBLEN*NJOBS  ;RESERVE SPACE FOR JOB DATA BLOCKS
0049  0190          JOBEND ANOP               ;DEFINE END OF JOB DATA BLOCK AREA
0050  0190
0051  0190
0052  0190                 END



Local Symbol Table

JOBAREA    0000 JOBEND    0190



0053  0000
0054  0000
0055  0000                 APEND FIREDOT,V254
0056  0000
0057  0000                 TITLE 'MULTITASKING SYSTEM SAMPLE JOB'
0058  0000
0059  0000          FIREDOTJOB START
0060  0000
0061  0000          ;-------------------------------+
0062  0000          ;       HI-RES PLOTTING EQUATES   '
0063  0000          ;-------------------------------+
0064  0000
0065  0000          HIRES  EQU  $F3E2  ;SET TO HIRES PLOT MODE
0066  0000          HICOLOR EQU $F6F8  ;SET HIRES COLOR
0067  0000          HIPLOT EQU  $F457  ;PLOT A HIRES POINT
0068  0000
0069  0000                 USING JOBCOMMON
0070  0000
0071  0000          ;--------------------+
0072  0000          ;  JOB SYSTEM EXAMPLE  '
0073  0000          ;--------------------+
0074  0000          BEGIN  ENTRY              ;BEGIN HERE
0075  0000
0076  0000 A2FF           LDX  #STACK         ;SET UP INITIAL STACK
0077  0002 9A             TXS
0078  0003
0079  0003 D8             CLD                 ;SET TO BINARY MODE
0080  0004
0081  0004 20E2F3         JSR  HIRES          ;SET TO HI-RES GRAPHICS MODE
0082  0007 200000         JSR  INITJOB        ;INIT JOB DATA BLOCKS
0083  000A
0084  000A A918           LDA  #<FIREDOT      ;PUT ADDRESS OF JOB
0085  000C 8502           STA  JOBTEMP        ;IN JOBTEMP FOR BETJOB TO FIND
0086  000E A900           LDA  #>FIREDOT
0087  0010 8503           STA  JOBTEMP+1
0088  0012 200000         JSR  BETJOB         ;SET UP THE JOB
0089  0015
0090  0015 4C0000         JMP  LASTJOB        ;START JOBS RUNNING
0091  0018
0092  0018
0093  0018
```

```
0094  0018          ;-------------------------------------------+
0095  0018          ;  SAMPLE JOB, FIRE A HI-RES DOT FROM LEFT TO RIGHT   +
0096  0018          ;  ACROSS SCREEN WHEN PLAYER HITS BUTTON 0            +
0097  0018          ;  FIRE A HI-RES DOT FROM RIGHT TO LEFT WHEN BUTTON 1 +
0098  0018          ;  IS PRESSED... STOP ALL JOBS EXCEPT THIS ONE        +
0099  0018          ;  WHEN SPACE BAR IS PRESSED                          +
0100  0018          ;-------------------------------------------+
0101  0018          FIREDOT ANOP
0102  0018
0103  0018 AD00C0         LDA  KEY            ;CHK FOR SPACE BAR PRESSED
0104  001B 1013           BPL  TRYFIRE        ;IF NO KEY PRESSED, SKIP
0105  001D
0106  001D C9A0           CMP  #$PCKEY        ;WAS SPACE BAR?
0107  001F F00A           BEQ  DOZAP          ;YES, GO STOP ALL JOBS
0108  0021
0109  0021 AD10C0         LDA  CLRKEY         ;NO SPACE BAR, GET SET FOR NEXT KEYPRESS
0110  0024 4C3500         JMP  TRYFIRE        ;CHK FOR PADDLE BUTTONS
0111  0027
0112  0027          DOZAP  ANOP
0113  0027 200000         JSR  ZAPALL         ;STOP ALL THE JOBS
0114  002A A964           LDA  0100           ;AND WAIT FOR A WHILE
0115  002C 200000         JSR  WAIT
0116  002F 20E2F3         JSR  HIRES          ;ERASE THE SCREEN
0117  0032 AD10C0         LDA  CLRKEY         ;SET UP KEYBOARD FOR A KEYPRESS
0118  0035
0119  0035          TRYFIRE ANOP
0120  0035 AD61C0         LDA  BUTTON0        ;TEST FIRE BUTTON 0
0121  0038 3008           BMI  FIRELEFT       ;FIRE A LEFT-GOING DOT IF PRESSED
0122  003A
0123  003A AD62C0         LDA  BUTTON1        ;ELSE TRY PADDLE 1 BUTTON
0124  003D 3020           BMI  FIRERIGHT      ;FIRE A RIGHT-GOING DOT IF PRESSED
0125  003F
0126  003F 200000         JSR  NEXT           ;ELSE SLEEP TIL NEXT TIME AROUND
0127  0042 4C1800         JMP  FIREDOT        ;GO TRY BUTTONS AGAIN
0128  0045
0129  0045          FIRELEFT ANOP
0130  0045 A9A1           LDA  #'DOTPLOT      ;PUT ADDRESS OF JOB
0131  0047 8502           STA  JOBTEMP        ;IN JOBTEMP FOR BETJOB TO FIND
0132  0049 A900           LDA  #>DOTPLOT
0133  004B 8503           STA  JOBTEMP+1
0134  004D 200000         JSR  BETJOB         ;GO FIND A JOB
0135  0050
0136  0050 A900           LDA  00             ;SET STARTING ?
0137  0052 A005           LDY  #YPOS          ;SAVE IN JOB DATA BLOCK
0138  0054 9102           STA  (JOBTEMP),Y
0139  0056 A004           LDY  #XPOS
0140  0058 9102           STA  (JOBTEMP),Y    ;STORE IN NEW JOB DATA BLOCK
0141  005A A007           LDY  #YVEL          ;NO Y VELOCITY
0142  005C 9102           STA  (JOBTEMP),Y
0143  005E
0144  005E A991           LDA  #$91           ;INIT VELOCITY FOR LEFT-MOVING DOT
0145  0060 A006           LDY  #XVEL
0146  0062 9102           STA  (JOBTEMP),Y    ;SAVE IN DATA BLOCK
0147  0064 4CB000         JMP  BUTDOWN        ;GO WAIT FOR PLAYER TO RELASE BUTTONS
0148  0067
0149  0067          FIRERIGHT ANOP
```

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CIRCLE 159 ON READER SERVICE CARD

```
0150  0067 A9A1        LDA   #<DOTPLOT      ;PUT ADDRESS OF JDB
0151  0069 8502        STA   JDBTEMP        ;IN JDBTEMP FOR GETJDB TO FIND
0152  006B A900        LDA   #>DOTPLOT
0153  006D 8503        STA   JDBTEMP+1
0154  006F 200000      JSR   GETJDB         ;GO FIND A JDB
0155  0072
0156  0072 A900        LDA   #0             ;SET STARTING Y
0157  0074 A005        LDY   #YPOS          ;SAVE IN JDB DATA BLOCK
0158  0076 9102        STA   (JDBTEMP),Y
0159  0078 A007        LDY   #YVEL          ;NO Y VELOCITY
0160  007A 9102        STA   (JDBTEMP),Y
0161  007C
0162  007C A9FF        LDA   #255           ;START THIS DOT AT RIGHT SIDE
0163  007E A004        LDY   #XPOS
0164  0080 9102        STA   (JDBTEMP),Y    ;STORE IN NEW JDB DATA BLOCK
0165  0082
0166  0082 A9FF        LDA   #$FF           ;INIT VELOCITY FOR RIGHT-MOVING DOT
0167  0084 A004        LDY   #XVEL
0168  0086 9102        STA   (JDBTEMP),Y    ;SAVE IN DATA BLOCK
0169  0088
0170  0088                BUTDOWN ANOP
0171  0088 AD61C0       LDA   BUTTON0        ;WAIT FOR PLAYER TO RELEASE BUTTON
0172  008B 1006        BPL   BUTBOK         ;GO IF RELEASED
0173  008D 208000      JSR   WEIT           ;ELSE WAIT
0174  0090 4C8800      JMP   BUTDOWN        ;AND CHK AGAIN
0175  0093
0176  0093                BUTBOK ANOP
0177  0093 AD62C0       LDA   BUTTON1        ;NOW CHECK IF OTHER BUTTON HAS BEEN RELEASED
0178  0096 3003        BMI   BUTIDOWN       ;ITS DOWN, GO WAIT AND CHECK AGAIN
0179  0098 4C1800      JMP   FIREBOT        ;BOTH BUTTONS ARE UP, GO BACK TO TOP
0180  009B
0181  009B               BUTIDOWN ANOP
0182  009B 208000       JSR   WEIT           ;IF NOT, WAIT
0183  009E 4C8800       JMP   BUTDOWN        ;THEN CHECK AGAIN
0184  00A1
0185  00A1
0186  00A1               DOTPLOT ANOP
0187  00A1 A200         LDX   #0             ;FIRST ERASE THE DOT
0188  00A3 20FBF6       JSR   HICOLOR        ;BY DRAWING BLACK OVER IT
0189  00A6
0190  00A6 A004         LDY   #XPOS          ;GET X POS FROM JDB DATA BLOCK
0191  00A8 B100         LDA   (JDBPTR),Y
0192  00AA AA           TAX                  ;PUT X POS IN X REG FOR PLOT ROUTINE
0193  00AB
0194  00AB A005         LDY   #YPOS          ;GET Y POS FROM JDB DATA BLOCK
0195  00AD B100         LDA   (JDBPTR),Y
0196  00AF A000         LDY   #0             ;CLEAR HI BYTE OF X POS
0197  00B1
0198  00B1 2057F4       JSR   HIPLOT         ;ERASE DOT
0199  00B4
0200  00B4
0201  00B4 200000       JSR   VELOCITY       ;ADD VELOCITY TO POSITION TO GET NEW POSITION
0202  00B7
0203  00B7 A203         LDX   #3             ;SET COLOR TO WHITE FOR PLOT
0204  00B9 20FBF6       JSR   HICOLOR
```

```
0205  00BC
0206  00BC A004         LDY   #XPOS
0207  00BE B100         LDA   (JDBPTR),Y
0208  00C0 AA           TAX                  ;STORE X POS IN X REG FOR PLOT ROUTINE
0209  00C1
0210  00C1 A005         LDY   #YPOS          ;GET Y POS FOR PLOT ROUTINE
0211  00C3 B100         LDA   (JDBPTR),Y
0212  00C5 A000         LDY   #0             ;CLEAR HI BYTE OF X POS
0213  00C7
0214  00C7 2057F4       JSR   HIPLOT         ;PLOT A POINT
0215  00CA
0216  00CA 200000       JSR   WEIT           ;GO DO WEIT JDB
0217  00CD
0218  00CD 4CA100       JMP   DOTPLOT        ;START AT TOP WHEN WE RETURN
0219  00D0
0220  00D0
0221  00D0          ;-------------------------------------+
0222  00D0          ;  ADD VELOCITY IN JDB DATA BLOCK TO  +
0223  00D0          ;  POSITION IN JDB DATA BLOCK TO GET  +
0224  00D0          ;  NEW POSITION FOR JDB               +
0225  00D0          ;-------------------------------------+
0226  00D0          VELOCITY ANOP                ;ADD VELOCITY TO CURRENT POSITION TO GET NEXT POS
0227  00D0 A006         LDY   #YVEL          ;GET Y VELOCITY
0228  00D2 B100         LDA   (JDBPTR),Y
0229  00D4
0230  00D4 A004         LDY   #XPOS          ;POINT AT X POS
0231  00D6 18           CLC
0232  00D7 7100         ADC   (JDBPTR),Y     ;ADD VEL TO X POS
0233  00D9 9100         STA   (JDBPTR),Y     ;STORE IN JDB DATA BLOCK
0234  00DB
0235  00DB A007         LDY   #YVEL          ;GET Y VELOCITY
0236  00DD B100         LDA   (JDBPTR),Y
0237  00DF
0238  00DF A005         LDY   #YPOS          ;POINT AT Y POS
0239  00E1 18           CLC
0240  00E2 7100         ADC   (JDBPTR),Y     ;ADD VEL TO Y POS
0241  00E4 9100         STA   (JDBPTR),Y     ;STORE IN JDB DATA BLOCK
0242  00E6
0243  00E6 60           RTS
0244  00E7
0245  00E7              END
```

Local Symbol Table

BEGIN	0000	BUTBOK	0093	BUTIDOWN	009B	BUTDOWN	0088
DOTPLOT	00A1	DOIAP	0027	FIREBOT	0018	FIRELEFT	0045
FIRERIGHT	00A7	HICOLOR	F6FB	HIPLOT	F457	HIMEM	F3E2
TRYFIRE	0035	VELOCITY	00D0				

```
0246  0000
0247  0000
```

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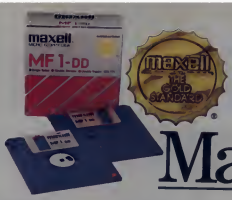
            ;-----------------------------------------+
            ;                                         +
            ;  INITIALIZE ALL DATA BLOCKS TO NOT USED +
            ;                                         +
            ;-----------------------------------------+
            ; EXPECTS:   NOTHING
            ; RETURNS:   NOTHING
            ; USES:      SAVES ALL REGS

INITJOB ENTRY
0000 48                 PHA                     ;SAVE REGS
0001 8A                 TXA
0002 48                 PHA
0003 98                 TYA
0004 48                 PHA
0005
0005 A900               LDA   #:JOBAREA         ;STARTING ADDRESS
0007 8500               STA   JOBPTR            ;OF JOB DATA BLOCK
0009 A900               LDA   #>JOBAREA         ;IN JOB DATA BLOCK POINTER
000B 8501               STA   JOBPTR+1
000D
000D A233               LDX   #¬JOBS            ;NO. OF JOBS TO INIT
000F A000               LDY   #STATUS           ;POINT AT STATUS BYTE OF JOB
0011
0011            INITLP ANOP
0011 A900               LDA   #0
0013 9100               STA   (JOBPTR),Y        ;SET STATUS TO NOT USED
0015
0015 A500               LDA   JOBPTR            ;GET ADDRESS OF NEXT JOB
0017 18                 CLC                     ;BY ADDING LENGTH
0018 6900               ADC   #JOBLEN           ;OF EACH JOB DATA BLOCK
001A 8500               STA   JOBPTR            ;TO CURRENT JOB DATA BLOCK ADDRESS
001C A501               LDA   JOBPTR+1
001E 6900               ADC   #0                ;PROPAGATE CARRY
0020 8501               STA   JOBPTR+1
0022
0022 CA                 DEX                     ;DEC NO. OF JOBS TO DO
0023 D0EC               BNE   INITLP              ;GO AGAIN TIL DONE
0025
0025 68                 PLA                     ;RESTORE REGS
0026 A8                 TAY
0027 68                 PLA
0028 AA                 TAX
0029 68                 PLA
002A 60                 RTS
002B
002C
```

```
002D
002D            ;-----------------------------------------+
002D            ;                                         +
002D            ;  SUSPEND EXECUTION OF THIS JOB        +
002D            ;  'TIL NEXT TIME THROUGH                +
002D            ;                                         +
002D            ;-----------------------------------------+
002D            ; EXPECTS:  CURRENT JOB DATA BLOCK ADDRESS IN JOBPTR,
002D            ;           PROGRAM COUNTER TO RESUME AT (-1) ON STACK
002D            ; RETURNS:  NOTHING, STOPS JOB 'TIL NEXT TIME THRU
002D            ; USES:     ALL REGS
002D
002D            NEXT   ENTRY
002D A901               LDA   #1                ;SET NO. OF TIMES THRU TO WAIT TO 1
002F A020
0030
0031
0032
0032            ;-----------------------------------------+
0032            ;                                         +
0032            ;  SUSPEND EXECUTION OF THIS JOB        +
0032            ;  FOR NO. OF TIMES IN ACCUMULATOR      +
0032            ;                                         +
0032            ;-----------------------------------------+
0032            ; EXPECTS:  CURRENT JOB DATA BLOCK ADDRESS IN JOBPTR,
0032            ;           PROGRAM COUNTER TO RESUME AT (-1) ON STACK,
0032            ;           NO. OF TIMES TO SKIP THIS JOB IN ACCUMULATOR
0032            ; RETURNS:  NOTHING, STOPS JOB FOR SPECIFIED NO. OF TIMES
0032            ; USES:     ALL REGS
0032
0032            WAIT   ENTRY
0032 A003               LDY   #COUNTER          ;GET SKIP COUNTER OFFSET
0034 9100               STA   (JOBPTR),Y        ;STORE NO. OF TIMES TO WAIT
0036
0036 68                 PLA                     ;GET LOW BYTE OF WAKEUP ADDRESS
0037 AA                 TAX                     ;SAVE IN X
0038 68                 PLA                     ;GET HIGH BYTE OF WAKEUP ADDESS
0039
0039 A002               LDY   #PCHI             ;GET OFFSET OF WAKEUP ADDRESS HI BYTE
003B 9100               STA   (JOBPTR),Y        ;STORE WAKEUP ADDRESS HI BYTE
003D A001               LDY   #PCLO             ;GET OFFSET OF LO BYTE OF WAKEUP ADDRESS
003F 8A                 TXA
0040 9100               STA   (JOBPTR),Y        ;STORE LO BYTE OF WAKEUP ADDRESS
0042
0042            NEXTJOB ANOP
0042 A500               LDA   JOBPTR            ;GET ADDRESS OF NEXT JOB DATA BLOCK
0044 18                 CLC                     ;IN JOB LIST BY ADDING LENGTH
0045 6900               ADC   #JOBLEN           ;OF DATA BLOCKS TO CURRENT ADDRESS
0047 8500               STA   JOBPTR
0049 A501               LDA   JOBPTR+1
004B 6900               ADC   #0                ;PROPAGATE CARRY
004D 8501               STA   JOBPTR+1
004F
004F A500               LDA   JOBPTR            ;NOW CHK FOR INVALID ADDRESS
0051 C900               CMP   #¬JOBEND          ;I.E. BEYOND END OF LAST JOB
0053 A501               LDA   JOBPTR+1
```



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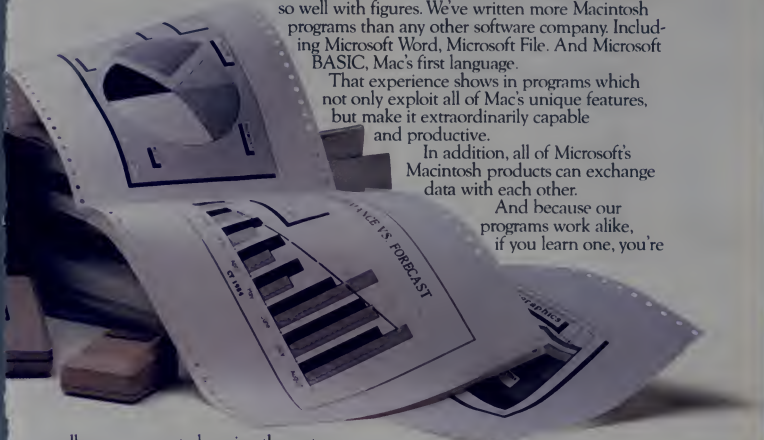

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```
#350  0050 E900          SBC   #>JOBEND
#359  0052 B01C          BCS   LASTJOB          ;IF BEYOND END, GO BACK TO FIRST JOB
#360  0054
#361  0054               GOJOB  ANDP
#362  0054 A000          LDY   #STATUS          ;ELSE CHK IF JOB ACTIVE
#363  0056 B100          LDA   (JOBPTR),Y       ;I.E. STATUS <> 0
#364  0058 F0E3          BEQ   NEXTJOB          ;GO TRY NEXT JOB IF NOT ACTIVE
#365  005A
#366  005A A003          LDY   #COUNTER         ;IF ACTIVE, DEC SKIP COUNT
#367  005C B100          LDA   (JOBPTR),Y
#368  005E 38            SEC
#369  005F E901          SBC   #1
#370  0061 9100          STA   (JOBPTR),Y
#371  0063 D000          BNE   NEXTJOB          ;IF COUNT <> 0 THEN SKIP EXECUTION THIS TIME
#372  0065
#373  0065 A002          LDY   #PCHI            ;IF HERE THEN GO EXECUTE JOB
#374  0067 B100          LDA   (JOBPTR),Y       ;JMP TO ADDRESS STORED IN JOB DATA BLOCK
#375  0069 48            PHA                    ;DO THIS BY PUSHING ADDRESS ON STACK
#376  006A A001          LDY   #PCLO            ;AND DOING AN RTS
#377  006C B100          LDA   (JOBPTR),Y       ;  AN INDIRECT JUMP WONT WORK
#378  006E 48            PHA                    ;  HERE AS THE 6502 INCS THE
#379  006F 60            RTS                    ;  RETURN ADDRESS BEFORE USE
#380  0070
#381  0070
#382  0070
#383  0070               LASTJOB ENTRY
#384  0070 A2FF          LDX   #STACK           ;IF HERE THEN ALL JOBS
#385  0072 9A            TXS                    ;HAVE BEEN EXECUTED ONCE
#386  0073               ;                      ;RESET STACK (IN CASE A JOB LEFT SOMETHING THERE)
#387  0073 A900          LDA   #<JOBAREA        ;RESET JOB DATA BLOCK POINTER TO TOP
#388  0075 8500          STA   JOBPTR           ;OF JOB LIST
#389  0077 A9B0          LDA   #>JOBAREA
#390  0079 8501          STA   JOBPTR+1
#391  007B 4C5400        JMP   GOJOB            ;AND START AGAIN
#392  007E
#393  007E
#394  007E
#395  007E               ;-------------------------------------+
#396  007E               ;                                     +
#397  007E               ;   FIND FIRST UNUSED DATA BLOCK      +
#398  007E               ;   IN THE DATA AREA                  +
#399  007E               ;                                     +
#400  007E               ;-------------------------------------+
#401  007E               ; EXPECTS:  NEW JOB'S FIRST PROGRAM COUNTER IN JOBTEMP
#402  007E               ; RETURNS:  ADDRESS OF DATA BLOCK IN JOBTEMP
#403  007E               ; USES:     SAVES ALL REGS
#404  007E
#405  007E               GETJOB ENTRY
#406  007E 48            PHA                    ;SAVE REGS
#407  007F 8A            TXA
#408  0080 48            PHA
#409  0081 98            TYA
#410  0082 48            PHA
#411  0083
#412  0083 A502          LDA   JOBTEMP
```

```
#413  0085 38            SEC                    ;DEC STARTING ADDRESS SO 6502 RTS WILL WORK
#414  0086 E901          SBC   #1
#415  0088 48            PHA                    ;AND TEMPORARILY SAVE ON STACK
#416  0089 A503          LDA   JOBTEMP+1
#417  008B E900          SBC   #0               ;PROPAGATE CARRY
#418  008D 48            PHA
#419  008E
#420  008E A900          LDA   #<JOBAREA        ;PUT START ADDRESS OF JOB LIST
#421  0090 8502          STA   JOBTEMP          ;TO SEARCH IN JOBTEMP
#422  0092 A900          LDA   #>JOBAREA
#423  0094 8503          STA   JOBTEMP+1
#424  0096 A000          LDY   #STATUS          ;LOOK AT STATUS BYTE OF EACH DATA BLOCK
#425  0098
#426  0098 B102    GETLP LDA   (JOBTEMP),Y      ;IF STATUS = 0
#427  009A F01A          BEQ   GOTONE           ;THEN THIS DATA BLOCK IS FREE TO USE
#428  009C
#429  009C A502          LDA   JOBTEMP          ;IF NOT, GET ADDRESS OF
#430  009E 18            CLC                    ;NEXT DATA BLOCK BY ADDING LENGTH
#431  009F 6908          ADC   #JOBLEN          ;OF DATA BLOCK TO CURRENT ADDRESS
#432  00A1 8502          STA   JOBTEMP
#433  00A3 A503          LDA   JOBTEMP+1
#434  00A5 6900          ADC   #0               ;PROPAGATE CARRY
#435  00A7 8503          STA   JOBTEMP+1
#436  00A9
#437  00A9 A502          LDA   JOBTEMP          ;CHK FOR INVALID JOB DATA BLOCK ADDRESS
#438  00AB C900          CMP   #<JOBEND         ;I.E. BEYOND END OF JOB LIST
#439  00AD A503          LDA   JOBTEMP+1
#440  00AF E900          SBC   #>JOBEND
#441  00B1 90E5          BCC   GETLP            ;IF ADDRESS OK, CHK IF FREE
#442  00B3
#443  00B3 201501        JSR   ERROR            ;NO JOB DATA BLOCKS LEFT, ERROR
#444  00B6
#445  00B6               GOTONE ANDP
#446  00B6 A000          LDY   #STATUS          ;SET STATUS <> 0 TO SHOW DATA BLOCK USED
#447  00B8 A901          LDA   #1
#448  00BA 9102          STA   (JOBTEMP),Y
#449  00BC
#450  00BC A002          LDY   #PCHI            ;POINT AT HI BYTE OF WAKEUP ADDRESS
#451  00BE 68            PLA                    ;GET STARTING ADDRESS FROM STACK
#452  00BF 9102          STA   (JOBTEMP),Y      ;AND STORE IT IN JOB DATA BLOCK
#453  00C1 A001          LDY   #PCLO            ;POINT AT JOB DATA BLOCK WAKEUP ADDRESS LO BYTE
#454  00C3 68            PLA                    ;GET LO BYTE OF WAKEUP ADDRESS FROM STACK
#455  00C4 9102          STA   (JOBTEMP),Y      ;STORE IN JOB DATA BLOCK
#456  00C6
#457  00C6 A003          LDY   #COUNTER         ;SET COUNTER TO 1 TOMAKE
#458  00C8 A901          LDA   #1               ;JOB EXECUTE NEXT TIME THRU
#459  00CA 9102          STA   (JOBTEMP),Y
#460  00CC
#461  00CC 68            PLA                    ;RESTORE REGS
#462  00CD AB            TAY
#463  00CE 68            PLA
#464  00CF AA            TAX
#465  00D0 68            PLA
#466  00D1 60            RTS
#467  00D2
```

```
0468  0002
0469  0002
0470  0002   ;-----------------------------------+
0471  0002   ; ZAP...                           +
0472  0002   ;   STOP THIS JOB FROM EXECUTING   +
0473  0002   ;   FOREVERMORE                    +
0474  0002   ;                                   +
0475  0002   ;-----------------------------------+
0476  0002   ; EXPECTS:  JOB'S DATA BLOCK ADDRESS IN JOBPTR
0477  0002   ; RETURNS:  DOESN'T RETURN
0478  0002   ; USES:     A, Y
0479  0002
0480  0002   ZAP ENTRY
0481  0002 68         PLA                     ;CLEAR RETURN ADDRESS OFF STACK
0482  0003 68         PLA
0483  0004 A000       LDY  #STATUS            ;POINT AT STATUS BYTE IN JOB DATA BLOCK
0484  0006 A900       LDA  #0                 ;ZAP JOB BY ZEROING STATUS BYTE
0485  0008 9100       STA  (JOBPTR),Y
0486  000A 4C3D00     JMP  NEXTJOB            ;SKIP TO NEXT JOB
0487  000D
0488  000D
0489  000D
0490  000D   ;-----------------------------------+
0491  000D   ; ZAPALL...                         +
0492  000D   ;   STOP ALL JOBS FROM EXECUTING   +
0493  000D   ;   EXCEPT THE CALLING JOB         +
0494  000D   ;                                   +
0495  000D   ;-----------------------------------+
0496  000D   ; EXPECTS:  CALLING JOB'S DATA BLOCK POINTER IN JOBPTR
0497  000D   ; RETURNS:  NOTHING
0498  000D   ; USES:     JOBTEMP
0499  000D
0500  000D   ZAPALL ENTRY
0501  000D 48         PHA                     ;SAVE REGISTERS
0502  000E 98         TYA
0503  000F 48         PHA
0504  00E0
0505  00E0 A900       LDA  #<JOBAREA          ;POINT AT START OF JOB DATA BLOCKS
0506  00E2 8502       STA  JOBTEMP
0507  00E4 A900       LDA  #>JOBAREA
0508  00E6 8503       STA  JOBTEMP+1
0509  00E8 A000       LDY  #STATUS            ;LOOK AT STATUS BYTE OF EACH DATA BLOCK
0510  00EA
0511  00EA   ZAPLP  ANOP
0512  00EA A502       LDA  JOBPTR             ;CHK IF THIS IT THE JOB
0513  00EC C502       CMP  JOBTEMP            ;WERE NOT SUPPOSED TO ZAP
0514  00EE D006       BNE  ZAPIT              ;IF NOT, GO KILL THE JOB
0515  00F0 A501       LDA  JOBPTR+1
0516  00F2 C503       CMP  JOBTEMP+1
0517  00F4 F004       BEQ  NOZAP              ;THIS IS IT, DONT ZAP IT
0518  00F6
0519  00F6 A900   ZAPIT LDA  #0                ;SET JOB TO INACTIVE
0520  00F8 9102       STA  (JOBTEMP),Y        ;BY ZEROING STATUS
0521  00FA
0522  00FA A502   NOZAP LDA  JOBTEMP           ;GET ADDRESS OF NEXT JOB DATA BLOCK
0523  00FC 18         CLC                     ;BY ADDING LENGTH OF JOB
0524  00FD 6900       ADC  #JOBLEN            ;TO CURRENT JOB DATA BLOCK ADDRESS
0525  00FF D502       STA  JOBTEMP
0526  0101 A503       LDA  JOBTEMP+1
0527  0103 6900       ADC  #0                 ;PROPAGATE CARRY
0528  0105 D503       STA  JOBTEMP+1
0529  0107
0530  0107 A502       LDA  JOBTEMP            ;CHK IF BEYOND END OF JOB DATA BLOCK AREA
0531  0109 C900       CMP  #<JOBEND
0532  010B A503       LDA  JOBTEMP+1
0533  010D E900       SBC  #>JOBEND
0534  010F 9004       BCC  ZAPLP              ;GO AGAIN IF OK
0535  0111
0536  0111 68         PLA                     ;ELSE RESTORE REGISTERS AND LEAVE
0537  0112 A8         TAY
0538  0113 68         PLA
0539  0114 60         RTS
0540  0115
0541  0115
0542  0115
0543  0115
0544  0115   ;-----------------------------------+
0545  0115   ; ERROR...                         +
0546  0115   ;   COME HERE WHEN AN ERROR IS     +
0547  0115   ;   FOUND...ERROR POINT ADDRESS    +
0548  0115   ;   WILL BE TOP TWO BYTES OF STACK +
0549  0115   ;-----------------------------------+
0550  0115   ; EXPECTS:  NOTHING
0551  0115   ; RETURNS:  NOTHING
0552  0115   ; USES:     NOTHING
0553  0115
0554  0115   ERROR  ENTRY
0555  0115 4C1501     JMP  ERROR              ;LOOP FOREVER
0556  0118
0557  0118
0558  0118           END


Local Symbol Table

ERROR    0115  GETJOB   007E  GETLP    009B  GOJOB    0054
GOTONE   008A  INITJOB  0000  INITLP    0011  LASTJOB  007D
NEXT     0038  NEXTJOB  007D  NOZAP     00FA  WAIT     002D
ZAP      0002  ZAPALL   000D  ZAPIT     00F6  ZAPLP    00EA


Global Symbol Table

BUTTON0   C0A1  BUTTON1   C0A2  BUTTON2   C0A3  CLRKEY   C010
COUNTER   0003  JOBLEN    0008  JOBPTR    0000  JOBTEMP  0002
KEY       C000  NJOBS     0033  PCHI      0002  PCLO     0001
SPCKEY    00A0  STACK     00FF  STATUS    0000  XPOS     0004
XVEL      0006  YPOS      0005  YVEL      0007
```

SPECIAL SECTION BUSINESS FORECASTING

Choosing and Using Business Forecasting Software

Glossary of Forecasting Terms

Business Forecasting Software in Brief

Forecasting Software Comparison Chart

Software Directory

Barry Keating

Decisions by people in business are almost always forward-looking. Most of these decisions are concerned with something that will take place in the future—something that is not known with certainty. Managerial decisions depend on the answers to such questions as:

- *What will GNP (Gross National Product) be this year? How high will the inflation and unemployment rates be?*
- *What will happen to tea sales if coffee prices increase this year?*
- *Is our production capacity too large or too small for the next three years?*
- *If we reduce price, how will our total revenue be affected? Would more advertising increase our profit?*
- *What will happen to the price of personal computers if a new model is introduced by Company X?*

Every business, not-for-profit firm, and government bureau must answer similar questions; the answers to all such questions require forecasting. So the problem of the manager is not whether to forecast, but rather how to forecast. Modern managers are taking advantage of the ease and availability of sophisticated forecasting afforded by microcomputers and relatively inexpensive software.

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Choosing and Using Business Forecasting Software

Every forecast you make is a "conditional" statement of what will happen in the future. The forecast depends on what also happens to the surrounding situation—the effect of coffee prices on tea sales depends upon consumer's expectations about future coffee prices, whether there is an excess supply of tea at current prices, and the exchange rate between the United States and tea/coffee producing countries. Every forecast is, then, limited by the "conditioning events" which surround the event to be forecasted.

Assumptions of Every Forecast

While instinct and estimates will always have their place in business (some of us are better than others at following hunches) managers are lately turning toward systematic and objective forms of forecasting. An objective forecast is simply one which results from the forecaster using a model to make the forecast. A model, we will see, is just a compact statement of the way you think things work. Any model used for forecasting today is based on three simple assumptions:

- Future occurrences are based, at least in part, on presently observable events.
- Things will behave in the future much as they have in the past.
- The relationships that have occurred in the past can be discovered by study and observation.

Systematic Forecasting

Systematic forecasting assumes that we can observe the underlying relationships that have occurred in the past by blocking out much of reality and building abstractions (models) which take into account only those things we feel are of prime importance in predicting something. It is no wonder that forecasters are accused of being simplistic and unrealistic—they are! In fact, to be simplistic is the only way to make any sense out of the complex relationships we face in the real world.

Forecasts may consist of predicting amounts, probabilities, or the timing of an event. We may all feel certain, for instance, that man will ultimately fly to Mars. If we were to predict *when* man would fly to Mars that would be a "timing forecast." If we were to predict the probability that the Dallas Cowboys would make it to the Superbowl, that would be a probability forecast. In this article we will deal with neither timing nor probability forecasts.

Here we will concentrate on predicting quantities. This is, by far, the most common form of business forecasting. If your company wants a sales forecast for next quarter, that is a quantity forecast. A cash flow forecast or an inventory forecast would also be a quantity forecast.

The systematic approach to forecasting may take the form of a carefully constructed model which the forecaster builds to mimic a real-world situation in which the assumptions are set up in strict mathematical form; this method is called econometrics. Or the forecaster's approach may be much less rigorous and much more dependent upon intuition and whatever data are readily available. Either approach to forecasting requires essentially the same statistical tools.

Widely Used Forecasting Techniques

While many techniques for forecasting require a thorough study of economics and statistics, we shall present a set of elementary forecasting techniques most of which are available in most of the software packages listed in the accompanying comparison chart. We purposely overlook some forecasting techniques (such as using leading indicators or surveys of economic intentions) which, while quite useful, do not directly incorporate computer models.

The techniques we will cover include:

- Linear Regression—a method for using one variable to predict a second variable.
- Multiple Linear Regression—a method for using more than a single variable to predict another variable.
- Time Series Analysis—a way of studying the movement of a variable over time in order to predict its future values.

Simple Linear Regression Model

A problem encountered by almost every manager is how to predict the value of some variable when the forecast variable is assumed to be dependent upon (or caused by) another variable.

For example, assume a carpet manufacturer finds that the number of residential building permits issued in a given quarter is strongly related to the company's carpet sales in the next quarter (this example is taken from the *Graph 'n Calc* manual).

The variable the manufacturer would like to predict is carpet sales, and the belief is that carpet sales are dependent upon the number of residential building permits issued in the previous quarter:

Carpet Sales	dependent variable
depend upon	
Last Quarter Permits	independent variable

In statistical terminology, carpet sales is called the *dependent variable* and permits last quarter is called the *independent variable.* The objective of the linear

regression model is to discover and measure the association between two variables. The usual reason for measuring the association is to aid in predicting one variable (the dependent variable) based upon the value of the other variable (the independent variable).

A standard convention in regression analysis is to use X to represent the independent variable and Y to represent the dependent variable. It is often useful to plot a scatter diagram of the variables to observe any possible relationship. The scatter diagram in Figure 1 is the plot of the information in Table 1 for carpet sales and building permits issued in the previous quarter.

Note that in Figure 1 the known variable—in this case permits issued last quarter—is plotted along the horizontal axis. The unknown variable by convention is plotted along the vertical axis. For the period to which our carpet sales and permit data pertain, *both* variables are known, but when the regression is used to forecast how large carpet sales will be, only permits, and not carpet sales, will be known.

While carpet sales may vary for many reasons the manufacturer has indicated that building permits last quarter (that is, lagged one quarter) are believed to be very predictive. Each point in Figure I represents the number of building permits issued in a given quarter and the corresponding carpet sales one quarter hence. The line was drawn to fit the points as closely as possible.

The carpet manufacturer could use Figure 1 to forecast carpet sales for the coming quarter if he knew the value of building permits issued this quarter. If, say, 350 permits were issued this quarter the manufacturer could forecast that carpet sales next quarter would be about 550.

The line we drew on the graph "to fit the points as closely as possible" might not, however, be the same you would draw through this same set of points. Since the points lie near the line but not precisely on the line, we can see that permits issued last quarter is not a perfect forecaster of carpet sales (if it were, all points would lie exactly on the line).

Simple linear regression will perform the task of choosing the line that best represents the points according to a decision rule set by statisticians some time ago. We are generally interested in *statistical relationships* when forecasting. If a statistical relationship exists between Y (carpet sales) and X (permits issued), the average value of Y tends to be related to the value of X, but it is impossible to predict with certainty the value of Y on the basis of a given value of X.

In our example, the amount of carpet sold tends to increase as the number of building permits issued increases, and this relationship *can* be used to forecast carpet sales if we know how many building permits were issued last quarter. But this relationship is far from exact. Since we, as forecasters, have not taken into account all the variables affecting carpet sales, it is impossible to forecast with certainty the exact amount of carpet sales.

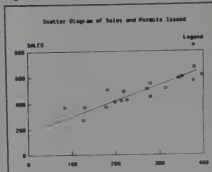
Simple linear regression describes how the dependent variable is related to the independent variable. Regression derives an equation for a line like the one in Figure 1 which can be used to estimate the dependent variable on the basis of known values of the other variable.

The term "regression" is used because Francis Galton, an English statistician of the last century, compared heights of parents with heights of offspring and found that very tall parents tended to have offspring shorter than their parents but that very short parents tended to have offspring taller than their parents. Thus the heights of offspring tended to "regress" toward some average height of the population. Because Galton used the technique we now know as regression to carry out the study, we now call the technique "regression" after its first important application.

Table 1.

OBS	SALES	PERMITS	ADVERT
1980.3	373.0000	130.0000	37.00000
1980.4	233.0000	127.0000	31.50000
1981.1	453.0000	280.0000	32.50000
1981.2	413.0000	199.0000	34.50000
1981.3	333.0000	144.0000	32.50000
1981.4	513.0000	272.0000	37.30000
1982.1	593.0000	343.0000	39.50000
1982.2	573.0000	377.0000	40.50000
1982.3	518.0000	314.0000	35.50000
1982.4	493.0000	219.0000	40.50000
1983.1	615.0000	396.0000	37.10000
1983.2	553.0000	278.0000	38.50000
1983.3	428.0000	227.0000	33.30000
1983.4	603.0000	351.0000	42.00000
1984.1	505.0000	162.0000	39.00000
1984.2	673.0000	379.0000	39.50000
1984.3	373.0000	179.0000	34.10000
1984.4	423.0000	214.0000	38.00000

Figure 1.



Listing 1.

```
 10 PRINT "MULTIPLE LINEAR REGRESSION"
 20 PRINT
 29 REM-SET ARRAY LIMITS TO X(N+1),S(N+1),T(N+1),A(N+1,N+2)
 30 DIM X(9),S(9),T(9),A(9,10)
 40 PRINT "HOW MANY OBSERVATIONS "
 50 INPUT N
 60 PRINT "HOW MANY INDEPENDENT VARIABLES "
 70 INPUT V
 80 X(1)=1
 90 FOR I=1 TO N
 95   PRINT
100   PRINT "OBSERVATION ";I
110   FOR J=1 TO V
119     REM - ENTER INDEPENDENT VARIABLES FOR EACH DATA POINT
120     PRINT "INDEPENDENT VARIABLE ";J:
130     INPUT X(J+1)
140   NEXT J
145   REM ENTER DEPENDENT VARIABLE FOR EACH POINT
150   PRINT "DEPENDENT VARIABLE ";
160   INPUT X(V+2)
170   FOR K=1 TO V+1
180     FOR L=1 TO V+2
190       A(K,L)=A(K,L)+X(K)*X(L)
200       S(K)=A(K,V+2)
210     NEXT L
220   NEXT K
230   S(V+2)=S(V+2)+X(V+2)^2
240 NEXT I
248 REM-STATEMENTS 250 TO 500 FIT CURVE BY SOLVING THE SYSTEM OF
249 REM-LINEAR EQUATIONS IN MATRIX A()
```

```
250 FOR I=2 TO V+1
260   T(I)=A(J,I)
270 NEXT I
280 FOR I=1 TO V+1
290   J=I
300   IF A(J,I)<>0 THEN 340
305   J=J+1
310   IF J<=V+1 THEN 300
320   PRINT "NO UNIQUE SOLUTION"
330   GOTO 810
340   FOR K=1 TO V+2
350     B=A(I,K)
360     A(I,K)=A(J,K)
370     A(J,K)=B
380   NEXT K
390   Z=1/A(I,I)
400   FOR K=1 TO V+2
410     A(I,K)=Z*A(I,K)
420   NEXT K
430   FOR J=1 TO V+1
440     IF J=I THEN 490
450     Z=-A(J,I)
460     FOR K=1 TO V+2
470       A(J,K)=A(J,K)+Z*A(I,K)
480     NEXT K
490   NEXT J
500 NEXT I
510 PRINT
520 PRINT "EQUATION COEFFICIENTS:"
525 PRINT "   CONSTANT:";A(1,V+2)
530 FOR I=2 TO V+1
540   PRINT "VARIABLE(";I-1;"):";A(I,V+2)
550 NEXT I
560 P=0
570 FOR I=2 TO V+1
580   P=P+A(I,V+2)*(S(I)-T(I)*S(1)/N)
590 NEXT I
600 R=S(V+2)-S(1)^2/N
610 Z=R-P
620 L=N-V-1
640 PRINT
650 I=P/R
660 PRINT "COEFFICIENT OF DETERMINATION(R^2)=";I
680 PRINT "STANDARD ERROR OF ESTIMATE";SQR(ABS(Z/L))
690 PRINT
699 REM -FORECAST DEPENDENT VARIABLE FROM ENTERED VALUES OF THE
    INDEPENDENT VARIABLE.
700 PRINT "FORECAST: (ENTER 0 TO END PROGRAM)
710 P=A(1,V+2)
720 FOR J=1 TO V
730   PRINT "INDEPENDENT VARIABLE ";J;
740   INPUT X
749   REM-TEST FOR END OF PROGRAM
750   IF X=0 THEN 810
760   P=P+A(J+1,V+2)*X
770 NEXT J
780 PRINT "DEPENDENT VARIABLE=";P
790 PRINT
800 GOTO 710
810 END
```

Table 2.

```
EQUATION COEFFICIENTS:
  CONSTANT:232.306478
VARIABLE(1):1.00318177

COEFFICIENT OF DETERMINATION(R^2)=.807913931
STANDARD ERROR OF ESTIMATE47.5580219

FORECAST: (ENTER 0 TO END PROGRAM)
INDEPENDENT VARIABLE 1?350
DEPENDENT VARIABLE=583.420096
```

To carry out regression analysis we need a method for finding the equation that minimizes the average squared deviation of the points from the line. Minimizing the average squared deviation is the method statisticians have agreed "fits" the best line to a set of points. This technique avoids large errors because the squaring of the deviations from the line places more emphasis on minimizing large errors as well as counting positive errors equally as important as negative errors (since all numbers squared are positive).

The regression program in Listing 1 will allow you to enter your own data, find the equation of the regression line, and forecast individual values of the dependent variable. The program as written is in Applesoft Basic but it is plain enough to run on almost any type of microcomputer. Using this simple program will give us a bit of the flavor of the commercial packages which are much easier to use and more powerful.

To use the program in Listing 1, type the program in, save it to disk for later use, and execute it with a RUN command. The program first prompts you for the number of observations. This would be 18 if we wish to use the data in Table 1.

You are next asked for the number of independent variables; this would be 1 if we wish to use *only* permits issued last quarter as a predictor.

The program then prompts for the 18 pairs of observations by requesting first the independent variable (permits) and then the dependent variable (carpet sales). After the last observation is entered, the program calculates and displays the equation for the regression line and some summary statistics which we will discuss.

The output in Table 2 shows the results we obtained from the program by entering the carpet sales and permit data. The "equation coefficients" define the regression line as:

Carpet Sales = 232.306478 + 1.00318177(Permits)

If we were to plot this line on the scatter diagram in Figure 1 it would look much like the "best fit" line which was drawn in freehand. The equation may be used to forecast carpet sales by substituting a known value for permits issued last quarter into the equation. If you know that permits issued last quarter were 350:

Carpet Sales = 232.306478 + 1.00318177(350)

or

Carpet Sales = 583.420096

Your estimate of carpet sales this quarter would then be about 583.

Summary Statistics

The summary statistics are measures of the goodness of fit of the regression line. Our simple program provides two measures for goodness of fit: the standard error of the estimate and the R-squared of coefficient of determination.

We have seen that the regression equation provides forecasts of the dependent variable for given values of the independent variable. The standard error of the estimate is a measure of the amount of scatter about the regression line. A rule of thumb often used by forecasters in interpreting the standard error of the estimate is to say that you may be 95% confident of any estimate of the dependent variable if you "bracket" the estimate by two standard errors.

For instance, using the equation in Table 2 we could estimate carpet sales of about 583 if permits were known to be 350. The standard error of 47.5 would tell us that we could be 95% certain that the real value of carpet sales would be between 583 + 2(47.5) and 583 − 2(47.5):

678 <—> 488

If asked how certain you are that real carpet sales would be around the 583 you predicted, you could safely answer that you are 95% certain that actual sales will be between 488 and 678.

Obviously, if the standard error is very small your "bracket" will be small; a large standard error may, likewise, give you such a large "bracket" that the forecast is useless. The standard error will be smaller if you are successful in finding an independent variable that is closely related to the dependent variable. So choose your variables with care!

The other summary statistic produced by the program is variously called the coefficient of determination or the R-squared. This statistic is also a measure of how well the regression equation fits the data. The R-squared for our example is read as 80.79 percent; that is 80.79 percent of the variation (i.e. the up and down movements) in carpet sales is explained by variation in permits issued. The other odd 19 percent of the variation is *unexplained* by the regression and probably occurs because other things affect carpet sales.

All of the software packages mentioned in the comparison chart that follows calculate at least these two summary statistics. Many of the packages calculate others as well; the serious forecaster would do well to learn to interpret these statistics in order to use regression analysis correctly.

Multiple Regression Model

Forecasters often wish to use more than one independent or predictor variable; this is where multiple regression becomes a useful technique. Whereas simple linear regression includes only one independent variable, multiple regression includes two or more independent variables. The reason for using more than one independent variable is to be able to predict *more accurately* the dependent variable. In the case of the carpet manufacturer, the firm may feel that factors other than permits issued have an important effect on carpet sales. For example, it may seem likely that carpet sales will tend to increase if advertising expenditures by the firm also increase:

Sales { dependent variable
depend upon
Last Quarter Permits { 1st independent variable
and
Advertising { 2nd independent variable

Another reason for using multiple regression instead of simple regression is that if the dependent variable depends upon more than one independent variable, a simple regression may result in a biased estimate of the coefficient of the independent variable. When a dependent variable is a function of more than one independent variable, running a simple regression on any one independent variable may be misleading. To estimate the true effects of any independent variable on the dependent variable, we must include *all* the independent variables in the regression (i.e., use multiple regression).

The program in Listing 1 also performs multiple regression, and its use is essentially the same as our previous example. Using the advertising data in Table 1 along with the sales and permits data gave us the output in Table 3 where variable (1) is advertising and variable (2) is permits issued last quarter. The regression equation (which now defines a plane in three-space rather than a line in two-space) would be:

Sales = −139.771666 + 11.6434849 (Adv.) + .779639035 (Permits)

Again, we could use this equation to forecast carpet sales this quarter if we knew permits issued last quarter and advertising expenditures. If permits were 300 and advertising were 37:

Sales = −139.771666 + 11.6434849(37) + .779639035(300)

or

Sales = 524.928986

Carpet sales would be estimated to be about 525 this quarter.

Summary Statistics Again

The summary statistics are also interpreted in a fashion similar to that used in simple regression. The standard error of the estimate may also be used in multiple regression to construct a confidence interval ("bracket") for any forecast. We may again use our rule of thumb

Table 3.

```
EQUATION COEFFICIENTS:
   CONSTANT:-139.771666
 VARIABLE(1):11.6434849
 VARIABLE(2):.779639035

 COEFFICIENT OF DETERMINATION(R^2)=.889768559
 STANDARD ERROR OF ESTIMATE37.2085677

 FORECAST: (ENTER 0 TO END PROGRAM)

 INDEPENDENT VARIABLE 1?37
 INDEPENDENT VARIABLE 2?300
 DEPENDENT VARIABLE=524.928986

 INDEPENDENT VARIABLE 1?37
 INDEPENDENT VARIABLE 2?250
 DEPENDENT VARIABLE=485.947034

 INDEPENDENT VARIABLE 1?
```

Table 4.

Graphin' Calc Matrix Data

File:CARS	1 AVANTI	2 BMW 320i	3 BMW 528i	4 BMW 633	5 BMW 733	6 CHEVETTE
1 HORSEPOWER	185	110	169	177	177	74
2 WEIGHT	2500	2520	2720	3430	3770	2040
3 MPG	14	19	17	16	12	23
4 WEIGHT/HPOWER	19	23	22	19	21	28
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-

File:CARS	7 MONZA	8 CAMARO	9 DAT 210	10 DAT 510	11 DAT 810	12 FIESTA
1 HORSEPOWER	90	130	65	92	120	66
2 WEIGHT	2720	3400	1995	2240	2755	1760
3 MPG	24	16	35	25	21	28
4 WEIGHT/HPOWER	30	26	31	24	23	27
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-

File:CARS	13 PINTO	14 MUSTANG
1 HORSEPOWER	88	130
2 WEIGHT	2425	2515
3 MPG	22	21
4 WEIGHT/HPOWER	28	19
5	-	-
6	-	-
7	-	-
8	-	-
9	-	-
10	-	-

Multiple Linear Regression -- Equation Coefficients & Statistics

Constant (y-intercept):		-9.0238
(4) WEIGHT/HPOWER		1.2153
Coefficient of Determination (R^2)	:	0.5779
Coefficient of Multiple Correlation	:	0.7602
Standard Error of Estimate	:	4.2585

Table 5.

MOVING AVERAGE RESULTS FOR DEMAND
WITH A BASE PERIOD OF 5

PERIOD	OBSERVED VALUE	SMOOTHED VALUE	RATIO
3	60	58.4	1.19
4	52	58.6	1.02
5	47	58.6	.85
6	51	58.2	1.01
7	60	51.2	1.17
8	42	51.2	.85
9	57	51.2	1.11
10	40	56.6	.7
11	56	57.8	.96
12	87	55.	1.58
13	49	57.4	.85
14	42	62.	.68
15	46	65.4	.70
16	85	77.6	1.15
17	98	84.4	1.16
18	98	91.2	.98
19	97	92.4	1.04
20	86	89.4	.96
21	91	90.8	1.
22	87	88.6	.9
23	97	89.2	1.08

in constructing the interval. We see from Table 3 that the standard error is 37.2085677 which is smaller than our previous standard error with simple regression. That is good for forecasting, because our confidence interval will be narrower; if our estimate of sales is about 524, the confidence interval will be between:

524 + 2 (37.2085677) and
524 – 2 (37.2083677) or
598 ⟷ 450

Note that when the extra independent variable is added to the forecasting equation, the size of the 95% confidence interval decreases.

The coefficient of determination can also be used in multiple regressions to measure how the regression equation fits the data. Our R-squared of 88.98% from Table 3 indicates a higher explanatory power for this multiple regression. Overall, our multiple regression appears to be a better tool for accurate forecasting than the simple regression.

Time Series Analysis

All business data are either *cross section* data or *time series* data. Cross section data pertain to measurement at a given point in time. For instance, data on automobile horsepower, auto weight, and miles per gallon, as listed in Table 4, are cross section data. As such, they could be used to estimate the regression equation also listed in Table 4 relating miles per gallon to the weight/horsepower ratio during a particular period (in this case, 1982).

Time series data pertain to measurements at a number of points. Our data on carpet sales in Table 1 are time series data. Sales figures are only one of a number of time series that are used by most companies.

Moving Averages

For some time series there is no simple mathematical function that neatly portrays long-run movement. For example, consider demand for an item as listed in Table 5.

Clearly, this time series does not exhibit a simple linear trend. Instead, demand bounced up and down until period 15 after which it took a large jump up and then continued jumping up and down but always at the new, higher level. In situations like this, forecasting is sometimes carried out using moving averages to "smooth" the time series. "Smooth" is simply a way of saying we are generating a smooth curve which shows the long-term movements in the series.

Table 6.

```
$ Rule                                  St Input   Name   Output   Unit   Comment
- ----                                  --------   ----   ------   ----   -------
Y=C+I+G              "GNP Identity                 Y      700      $      GROSS NATIONAL PRODUCT
C=100+.75*Y          "Consumption Function         C      625      $      CONSUMPTION
I=30                 "Investment Function    30    I                $      INVESTMENT
G=45                 "Government Spending    45    G                $      GOVERNMENT SPENDING
T=.29*Y              "Taxes                        T      140      $      TAXES
```

Consider Table 5 which includes the observed values and smoothed values made by using a moving average (Table 5 is produced with *DSM*). The smoothed value is a five-period moving average. For example, the smoothed number in period 8 is 50.2. It is calculated as follows:

$$50.2 = \frac{51 + 60 + 43 + 57 + 40}{5}$$

where the average is taken over five periods centered on the eighth period. Of course, a five-period moving average is not the only kind. We could, for example, compute a seven-period moving average. The important concept to note is that if the time series data contains fluctuations that tend to recur, that effect can be eliminated by using averages in which the number of periods included equals the period of the fluctuation.

The forecast is made by using the latest moving average as the forecast for the next period. Thus, after ten data points had been collected, our forecast of demand in future periods would be 50.2.

Econometric Time Series Models

In recent years, forecasters have been moving from simple forms of extrapolation in time series (such as moving averages) to the construction of systems of equations which show the effects of numerous independent variables on the value they wish to forecast.

The Wharton Model of the University of Pennsylvania is the archetypical example of an econometric time series model. The model in Table 6 is a miniature version of such a model (this table is produced with *TK!Solver*). The model describes an entire economy (such as the U.S.) with just five equations, each describing a different aspect of the economy.

The individual equations in Table 6 may be estimated using regression analysis or may be "identities" like the G = 45 equation. The entire system of equations may be used to forecast GNP (labeled as Y in the model) given known values of Investment (I) and Government Spending (G).

The solution to the model (which could also be called the forecast) is shown in the *TK! Solver* output in Table 6. Those values in the "output" column are the values given by the program once the user inputs values for G and I. Given the G and I values, those are the only values that solve the model.

Only *TK! Solver* of the packages we have seen is capable of working with systems of equations in this "automatic" manner, but many spreadsheet programs such as *Symphony* can be used with models. Consider the following multiple equation model:

Sales = 6.0 + 6.4 (Advertising) + 1.01 (Sales$_{-1}$)
Costs = Fixed Costs + Variable Costs
Variable Costs = .75 (Sales)
Fixed Costs = 3000
Earnings Before Taxes = Sales − Costs
Taxes = .48 (EBT)
Profit = EBT − Taxes

A model of this type is quite easy to enter into a spreadsheet program for the purpose of developing a range of forecasts for profit given various estimates of sales. The impact of factors other than sales on profits could also be examined by changing the appropriate information and calculating profits again. The real value of the spreadsheet approach, of course, comes from the ability to work with rather large, complex models. ■

The Wharton Model

One of the largest and best known forecasting models is the Wharton Model named after its proprietors, the Wharton School of the University of Pennsylvania.

Unlike most of the models mentioned in this section, the Wharton Model is not a single equation model but is actually composed of more than 200 equations. The model (with timely updating) has been used for more than ten years. It is designed to forecast gross national product (GNP), the rate of inflation, the unemployment rate, and a host of other, more specialized variables.

By using some of the methods presented here, the equations in the model are re-estimated from time to time. The 200 equations interact with one another to predict final results. There are four categories of equations in the model:

- Spending equations which seek to predict automobile expenditures, durable goods spending, etc.
- Investment equations which predict business purchases.
- Output equations which explain production levels and can be used to predict employment rates.
- Miscellaneous equations to explain interest rates, wages, inflation, etc.

Traditionally the Wharton Model has been used every three months to predict the course of the economy over the next two years. During periods when the structure of the economy has been stable, the model has performed remarkably well. When the structure of the economy itself changes (that is, when the rules of the game change) as it did in 1971 when wage and price controls were instituted by the Nixon administration, the model fares much more poorly. ■

Glossary of Forecasting Terms

Budget Forecasting Model. A model generally used to consolidate budget information provided by separate departments using standard accounting practices. It may include capabilities to generate forecasts of cash flow, earnings per share, and other financial ratios resulting from performance according to budget. Such models are usually incorporated into "spreadsheet" programs such as *VisiCalc, Symphony,* and *Multiplan.*

Corporate Model. A mathematical representation or simulation of a company's accounting practices and financial policy guidelines. It is used to project financial results under a given set of assumptions and to evaluate the financial impact of alternative plans. Long range forecasts are also calculated using such models. Such a model would ideally be put into an "equation processor" like *TK! Solver,* but spreadsheets are often used.

Data. Individual pieces of quantitative information, e.g. dollar sales of carpets, numbers of building permits issued, units of raw material on hand.

Descriptive Statistics. The numerical values representing important features of a set of quantitative information such as the arithmetic mean, range, standard deviation, ratios, percentages, and rates of change.

DIF files. DIF stands for "data interchange format" and is a particular standard for data files. It is used by many programs involving forecasting and allows files created on one software package to be read by another software package—perhaps one produced by an entirely different company. DIF files are *not* interchangeable between different machines; an Apple DIF file disk cannot be read directly into an IBM machine. While the files are compatible, the disks are formatted differently for different machines. Programs using DIF files include *VisiCalc, VisiTrend/Plot, Symphony, Lotus 1-2-3, MicroTSP, Daisy, SmartForecasts,* and many others.

Exponential Smoothing. A weighted, moving average method of forecasting in which past observations are geometrically discounted according to their age. The heaviest weight is assigned to the most recent data. The smoothing is called "exponential" because data points are weighted in accordance with an exponential function of their age.

Forecast. The extrapolation of the past into the future. It is usually an objective computation involving data, as opposed to a prediction, which is a subjective estimate incorporating the manager's anticipation of changes and new influencing factors.

Hard Disk. A magnetic storage device permanently mounted inside the computer (or inside its own separate case). A single hard disk has storage capacity equivalent to dozens of floppy disks.

Macroeconomic Forecasting Model. A model or simulation which can be used to forecast gross national product (GNP), personal income, employment, price levels, and other indications of economic performance. The Wharton Model is an example.

Moving Average. A method of averaging out the roughness of random variation in a data series. A moving average uses only the most recent historical data in the series. The method gets its name from the way it slides along the data series, averaging each data point with its immediate predecessors.

Multiple Regression. A statistical technique for predicting the value of a "dependent variable" which is assumed to be dependent upon one or more explanatory or "independent variables."

Simple Regression Analysis. A statistical technique for predicting the value of one variable in terms of the given value of another variable.

Sales Forecasting Model. A model used to simulate annual sales for each period of a forecast. The input factors can include market size, selling price, market growth rate, share of the market, measures of competitors' actions, etc. Such forecasts often use equations estimated with regression analysis and then placed in a spreadsheet program.

Simulation. The technique for utilizing a representative or artificial operating and demand data to reproduce conditions that are likely to occur in the actual performance of a system. Most simulations are multiple equation models which mimic some real world situation.

Smoothed Data Value. In forecasting methods based on exponential smoothing or moving averages, the statistical approximation to the actual value of the forecast variable.

Spreadsheet. Any one of a number of programs which arrange data and formulas in a matrix of cells. *VisiCalc* is the best known of the commercial spreadsheets. Many forecasting programs use the spreadsheet form to enter, display, and store data.

Time Series. An ordered succession of numbers representing the values of a particular variable over a given period of time (e.g. monthly sales figures for 1970 through 1985). ■

Business Forecasting Software in Brief

Many software packages are capable of at least a few of the forecasting techniques discussed in the previous section. Some of the more comprehensive business forecasting packages are briefly reviewed in the following pages and are compared in a chart at the end of the section.

VisiTrend/Plot

Available for both the Apple and IBM, *VisiTrend/Plot* is a combined time series analysis and graph plotting system. Without a doubt, it is the most attractive package for use by those who need both forecasting tools and presentation graphics. (*Statpro* also excels in graphics but is much more expensive.)

As the comparision chart details, *VisiTrend/Plot* is a complete aid to forecasting. It includes menu-selected options for regression, moving averages, trend analysis, smoothing, and descriptive statistics among others.

The data editor (called a "storage management program") is simple to use and complete. It allows many transformations of the data selected directly from the menu (sums, ratios, leads, lags, logs, or any mathematical or logical transformation defined by a user) and displays the results (with scrolling) of those operations for a quick check on accuracy. The storage management program can read and save DIF files, but it is unable to read or store standard text files (this may make it more difficult to use *VisiTrend/Plot* if you routinely download data from a mainframe in a standard text file format).

One of the strong features of *VisiTrend/Plot* is the plotting program which produces all the standard business graphics: pie charts, scatter diagrams, bar charts, single and multiple line charts, and overlays. All this is done in color if you desire, and all the graphics may be saved to disk or printed on a wide range of supported graphics printers (Epson, IDS, NEC, etc.). Since you may either automatically scale the plots or

One of the strong features of VisiTrend/Plot is the plotting program which produces all the standard business graphics.

use your own scale and since you may also place labels anywhere on the plots, *VisiTrend/Plot* offers a superior method for presenting forecasts in visual format.

Daisy

Daisy stands for Data Analysis Interactive System. It is a complete statistics package with some limited graphics capability available only for the Apple II computers. At $199.95 it is a bargain for serious forecasters and others who require statistical processing.

Its most attractive feature is perhaps the ability to store and display data in spreadsheet format. With an Apple IIc or IIe with an extended 80-column card the spreadsheet is 10 columns by 830 rows and can be adjusted in size to incorporate more columns and fewer rows (e.g., 20 columns by 480 rows). Of course, you view only a portion of the large spreadsheet at one time, but you may scroll the sheet with the cursor control keys. As in *VisiCalc* this is the easiest way to view large datasets; a splitscreen mode allows non-adjacent columns to be placed next to one another for visual comparison.

Entry of data into the spreadsheet may take place by way of the keyboard or from disk using any DIF database. This means information residing in *VisiCalc* files can be directly used by *Daisy*. Data may be saved in standard *Daisy* files (which load quite rapidly), DIF files, or standard ASCII text files. The latter is quite useful if the data are to be transmitted by modem.

Transforming data in any way is quite simple with many selections available directly from a menu (lagging data, taking logs, etc.). Unusual transformations can be programmed by writing an extension to *Daisy* (complete instructions are in an appendix to the well written manual). Missing data are also handled.

While *Daisy* does not handle moving averages or exponential smoothing, it does handle just about every variation of regression analysis. Complete summary statistics are supplied for each regression. Forecasts using the regression equation are also available.

All output from regression (as well as the other statistical routines provided) may be printed. Some limited graphics may also be produced and viewed or printed (scatter diagrams, histograms, sequence plots, etc.).

In addition, *Daisy* provides the following statistical routines: descriptive

statistics, hypothesis testing, correlation analysis, crosstabulation, nonparametric corellation, and ANOVA.

The manual includes a tutorial, and there is a Help command available on disk for on-line instruction. The 80-column display is used in many instances if your machine has that capability; otherwise, the program reverts to 40-columns.

MicroTSP

MicroTSP will be recognized by some business school graduates as a microcomputer version of the TSP (time series processor) package available on many business school mainframe computers. *MicroTSP* is specifically designed for statistical analysis of data when forecasting is the objective.

The *Micro TSP* manual includes specific examples of forecasts computed using the packages as well as a data disk with all the data from the various examples. This is a welcome extra for users new to forecasting who wish to work through the examples in the manual.

MicroTSP is specifically designed for statistical analysis of data when forecasting is the objective.

The two major case studies included on the data disk are a study of telephone demand using basic regression techniques and a sales forecasting model using more sophisticated regression techniques. Also included are examples of forecasting auto sales and the treasury bill rate.

One decided advantage of *MicroTSP*, which is available in both Apple and IBM versions, is its ability to use DIF files which are compatible with programs like *VisiCalc*. The *MicroTSP* manual even includes an extended example of how to take information from the Holiday Inn forecasting demonstration and transfer the results to *VisiCalc* to compute projected occupancy rates, projections of total revenue, and forecasts of related variables. Of course, the real power of *VisiCalc* becomes available when you begin reconsidering the assumptions underlying the model constructed with the aid of *MicroTSP*.

Data for use in forecasting models can be obtained by telephone using your micro to capture the data and then converting that data to a form usable by *MicroTSP*. Once in the *MicroTSP* package, a one-key command converts the file to DIF format if you wish to use the data in other programs.

Some very simple graphics (scatter diagrams, residual plots, etc.) are produced by *MicroTSP*, and transformations of any data are very simple to invoke the GENR (generate) command. A comprehensive data editor allows for easy housekeeping in the data files. The package can be set up to run "batch" jobs if you wish to leave the machine unattended while running many routines. Also included in the software is the capability of running quite sophisticated regression techniques (two stage-least squares and Cochrane-Orcutt two-stage iteration models). References for advanced techniques are provided in the manual.

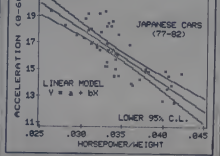
Statpro

Statpro has been around in an Apple version for some time but is now available for the IBM PC and PC XT.

The software is actually an integrated statistics, database, and graphics package with comprehensive coverage in each area. A smaller, more directed offshoot of *Statpro* will soon be available for the IBM. Its title is *The Forecaster*, and it is promised to include the most often used forecasting tools from *Statpro*.

For the forecaster, *Statpro* is the most complete package of those we have reviewed. It is the closest thing to using a mainframe statistical package like SAS or SPSS, but it also includes some bells and whistles that no mainframe package has.

Every conceivable way to transform the data is included in the database section of *Statpro*: leading and lagging (called "offsetting" in *Statpro*), missing data provisions, and range checking to eliminate errors. If you use a hard disk, information retrieval and storage time is greatly reduced.



Plot made with Stat Pro.

Data are *not* stored in DIF files in the Apple and IBM PC versions but rather in a Pascal format making it virtually impossible to exchange information between *Statpro* and other programs. Standard text files would also be difficult to read into *Statpro*. Wadsworth has promised a module in early 1985 to allow the IBM version to read DIF files. The PC XT version has none of these drawbacks. It is already able to read and process both ASCII files and the popular DIF files.

The available statistics in *Statpro* covers everything listed in the comparision chart as well as a list of statistical procedures usually found only in statistics textbooks. If you have used SAS or SPSS on a mainframe, you will be at home in the *Statpro* statistical menu.

For simple regression alone you can choose between fitting a linear equation (as we did with the program listing in this article in the carpet sales example) and one of up to 16 other forms of regression

If you have used SAS or SPSS on a mainframe, you will be at home in the Statpro statistical menu.

(exponential, Gompertz curve, logistics curve, etc.). For time series analysis, *Statpro* offers moving averages, multistage least squares, polynomial and trig functions, and exponential smoothing. Even seasonal indices can be computed by *Statpro*.

The third part of the package, "graphics workstation," can display most of what you have calculated in various ways. It is the most complete graphics module in any of the packages listed here and is actually more like a separate, and quite complete, graphics generator.

DSM

DSM stands for Decision Support Modeling. It is a rather comprehensive statistics and operations research package for IBM and MS-DOS compatible computers. For forecasting purposes, the package has a complete regression module capable of handling up to 15 variables at one time. A forecast command allows easy computation of fore-

casts after an equation has been estimated.

File management is quite simple with a full range of transformations allowed on the variables: log, reciprocal, square root, square, and formula. *DSM* does have the ability to read data from some database and spreadsheet programs. There is an editor for data files, and you can print *any* screen (data or otherwise) at will.

In addition to regression, *DSM* provides moving averages and exponential smoothing. Other capabilities of *DSM*, not directly related to forecasting, are: linear programming, inventory modeling (using simulation), PERT (program evaluation and review technique), queueing, and breakeven analysis (using simulation).

Note that two of the models in *DSM* use simulation as the technique for modeling or forecasting inventory and predicting breakeven points. These models are menu-controlled, so no active programming experience is required. They are the first sophisticated uses of simulation we have seen on a microcomputer for business users, and they put the awesome power of simulation in the hands of non-programmers.

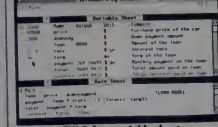
Since *DSM* is provided to educational institutions as an educational tool, the company also provides a student workbook to help first-time modelers use the program. The workbook was not included in the package but is said to be available separately for $8.95. A demonstration disk is also available for $15.

TK! Solver

Without question, this is the most innovative software we have seen recently. In its narrow application corridor it is king.

TK! Solver is an equation solver or, more accurately, an equation system solver. It is the only package of its kind on the market. But just exactly what does it do?

You enter equations on a "rule sheet" like those in Table 6 which define a situation—in this case, the derivation of gross national product for an economy—and press the exclamation point key; *TK! Solver* finds the unknown values and displays them on a "variables sheet." You can solve for all unknown variables by exchanging known with unknown variables without reformulating *the equations*.



TK! Solver variable sheet.

If a model or system of equations cannot be solved directly, *TK! Solver* can be instructed to approach the answer in successive iterations until it converges on the solution. The manual describes this feature as "a method of problem solution that uses successive approximations of the answer to converge to a desired mathematical result."

This could be useful in situations where the same unknown is on both sides of the equation. Other uses of this feature include the solution of systems of simultaneous equations where the relationships between the unknowns are not adequately defined to allow direct solution.

Moving around on any of the *TK! Solver* "sheets" is much like scrolling around a *VisiCalc* spreadsheet. Changes to existing models are easy to make, and recalculation is just an exclamation point away. The package does not handle numerical integration techniques or matrix operations (rarely used in forecasting) and is only for the purpose of finding real-number solutions; it will not handle "general" or "symbolic" solutions.

A users group with its own journal is supported by Software Arts and some *TK! SolverPacks* are available for specific applications (such as financial management techniques). Among the formulas included in the *TK! SolverPack* for financial management are compound interest, net present value/internal rate of return, level debt service analysis, bond swap analysis, bond refunding decisions, convertible debt analysis, financial statement ratio analysis, capital asset pricing model applications, and Black-Sholes option pricing.

TK!Solver has the ability to produce plots of the outcomes of its calculations. When calculations have been made, the results can be plotted on an X-Y line graph showing one list against the values in all other specified variable lists. The plots can be viewed on the screen or printed using standard ASCII characters on most printers.

While the package is *not* a general tool for forecasting, in some specific

Forecasting With Integrated Packages

While we have not reviewed any integrated software, we would be remiss if we did not mention the ability of the integrated packages to forecast. By an integrated package we mean software like *Symphony, Lotus 1-2-3, Framework, Visi On, Lisa 7/7 Office System*, and similar tools.

None of these integrated packages (with the notable exception of *Lisa 7/7*) performs forecasting "right off the shelf," but each of them may be easily modified for forecasting—usually by using a "template" for the spreadsheet part of the integrated package. Some of these templates (blank spreadsheet pages with the equations for calculations already entered) are commercially available and more are sure to come as individuals wish to use their integrated packages for forecasting and other statistical analysis.

Howard W. Sams, for instance, sells *Financial Planning* for use with *1-2-3. Financial Planning* includes templates for regression and descriptive statistics as well as for many financial types of analysis (Sams was not sure whether the templates would work with *Symphony*). The *Lisa 7/7 Office System* includes multiple regression right in the spreadsheet package, complete with summary statistics. That makes forecasting a snap using the integrated system and files in DIF format.

If a model or system of equations cannot be solved directly, TK! Solver can be instructed to approach the answer in successive iterations until it converges on the solution.

applications it may be the greatest thing since peanut butter. The documentation for *TK! Solver* assumes the user has no prior experience with the computer hardware and includes a complete tutorial with practice in moving from one "sheet" to the next and setting up various types of models (some examples are included).

A Help command on-line is loaded by typing ?, which then asks for the topic on which help is needed. A mini-tutorial on that topic is then scrolled across the screen. The software is available for the IBM PC (and other MS-DOS machines), Wang PC, DEC Rainbow, DEC Professional 350, Apple IIe with an extended 80-column card, and Macintosh.

TK! Solver is well suited to the knowledge processing philosophy on which Macintosh is based. The program uses many of the Macintosh enhancements: the mouse as a pointer, very high resolution plotting (and printing), 12-digit precision, recognition of very small numbers, expanded error diagnosis, cut and paste, and access to Macintosh desk accessories.

The *TK! SolverPacks* are also available for Macintosh, but, surprisingly, the Macintosh price for the program and the add-on packages is below both the IBM and Apple II prices ($249 for Macintosh *TK! Solver* and $59 for each *TK! SolverPack*).

The great advantage of integrated software, of course, is the ability of the programs to put information somewhere else *or* to get the information from somewhere else. Many of the packages include communications software (*Symphony, Lisa 7/7 Office System, Framework, Open Access*). This feature allows the downloading of data from a corporate mainframe, another microcomputer, or a commercial database (such as Newsnet) for analysis in the integrated packages. Since all of these packages also include a word processor, they may also be used to formulate reports which include the forecasts and, in some cases, graphic representations of the forecasts as well.

Be aware, however, that these packages (with the exception of *Lisa 7/7*) are *not* set up to do forecasting as you purchase them off the shelf. Either you must write your own templates for the spreadsheet or you must find a commercially available set of templates. ■

Graph N' Calc

Graph N' Calc uses a spreadsheet to allow data entry and transformations. Available only for the Apple III, the spreadsheet is only 10 rows by 100 columns and *cannot* be reconfigured to include fewer columns and more rows.

This can be a distinct disadvantage, because it severely limits the number of variables and transformations you can have available for analysis at one time (even though you may be using only a few at a time). The spreadsheet can be reviewed by scrolling to the left or right (all ten rows are shown at all times).

Transformations are easily handled from the menu, but the transformations available are limited to logs, square roots, arithmetic functions, and absolute values. Other calculations can be inserted into "user modules" by programmers following the instructions in the manual.

While the moving average technique is not available, *Graph N' Calc* seems made for forecasters because of the inclusion of three versions of exponential smoothing and a regression routine. The regression routine supplies few summary statistics, however, and there is no provision for lagging data which is often important to forecasting.

Graphics are nicely portrayed by *Graph N' Calc* from any data in the spreadsheet. In addition to displaying regression lines and scatter plots, the program is also capable of producing bar charts, pie charts, and high-low volume charts. There is also a module which allows you to create "slides" and show them in slide projector fashion. There is no provision, however, for creating "text slides" to bridge the displays of graphics material and supply forecast results in tabular form.

The manual contains a tutorial which explains the operation of the system. In addition, a second book, *Fundamentals of Forecasting*, is packaged with the program. Taken together, the two books should allow even a neophyte to create decent forecasts, assuming adequate data.

SmartForecasts

SmartForecasts, available only for the IBM PC, is a software package aimed directly at forecasters. It offers both graphical and statistical tools from a command type system similar to *Daisy* and *MicroTSP*. As in *Daisy*, data are stored and viewed in a spreadsheet format capable of holding up to 150 observations of 15 different variables.

SmartForecasts can read DIF files and thus is compatible with *VisiCalc* and *Lotus 1-2-3*. The spreadsheet is viewed with a SEE command which moves the window to the desired position much like the GO TO command in spreadsheet programs. Scrolling in not available.

Transformations of the data are effected by using the DEFINE command to create the new variable by using some arithmetic operation, a functional transformation, or time shifting. Functional transformations include logs, exponentials, rounding, and square roots.

The statistical analysis portion of the program includes several features that make the *SmartForecasts* environment particularly enjoyable to use:

- Function keys and short commands eliminate nested menus which are time consuming (*Daisy, ESP*, and *MicroTSP* also use the command form of interface).
- An OOPS command can immediately undo any mistake in manipulation.
- The entire program is on one disk.
- There is an on-line help command *which senses the context of your inquiry.*

One unique feature is an "eyeball forecasting" routine which allows you to use *interactive graphics* to make forecasts. The EYEBALL command permits you to complete two alternative forecasts of some variable, say sales. The software treats one forecast as the "champion," while the other is the "challenger." You can refine the forecasts until you make one you prefer to the current champion; at that time the labels switch since you have identified a new champion. You even have the ability (although we question its value) to draw a "manual" forecast directly on the screen. By moving a cursor around the screen and identifying points (or by us-

ing the numeric keypad) data are manually entered to create a challenger.

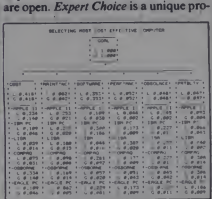
"Multiseries forecasting" is a feature that is potentially handy for users who wish to forecast more than a single series at once. Suppose you have three different product lines and wish to see the forecasts for all three at once over the next three months. That requires only a short set of commands in *SmartForecasts*.

For forecasters who must deal with data which exhibit seasonality (variations which occur regularly from season to season), *SmartForecasts* may be the best available package. It calculates seasonal adjustment factors, and the manual includes a complete explanation of how to use them (*ESP* also does a nice job in this area). Since seasonality is at the root of many business uses of forecasting, it would seem to make sense to use a package that addresses the situation directly. It is surprising to us that many so-called forecasting packages do not deal directly with seasonal data. Failure to do so in most forecasting situations can lead to serious misinterpretation of the forecasts.

A technical reference section in the manual is quite useful for statistically-inclined users who wish to see the actual solution routines displayed for each analysis procedure in the software. For those with a statistics background this will make clear whether the correct technique has been chosen for a given situation.

Expert Choice

Consider the situation of forecasting the most cost effective computer for your office to use. Now this is not quite like the forecasting situations presented earlier, but it is a decision involving future consequences for which many alternatives are open. *Expert Choice* is a unique program designed to handle a special case of decision making. The *Expert Choice* tree (much like a decision tree but upside-down) has the root at the top with branches on the next level. The criteria for the decision (chosen by you) are listed just under the goal: cost, performance, maintenance, obsolesence, software, and portability.



Expert choice: Decision tree.

Judgments of the relative position between pairs of computers covering each decision criterion are entered by answering questions presented in verbal fashion (but you can insert numerical values directly once you get the hang of using the program to speed up data entry). Once your preferences are entered, *Expert Choice* calculates the priorities and displays results along with an inconsistency index (which shows how consistent your judgments between pairs of computers on each criterion were—if you receive less than 1.00, the tree is considered satisfactory).

Expert Choice is a unique program designed to handle a special case of decision making.

Computers can be compared on all six criteria at once or on one criterion at a time; more detailed trees can also be produced with more levels from top to bottom and more criteria across (with virtually no size limit).

Office relocation, house selection decisions, employee evaluations, make or buy decisions, risk evaluation in lending—all these are suggested uses of *Expert Choice*. While many decisions about future actions could be considered with *Expert Choice*, its most important feature may be that it forces you to be explicit about the goals of any decision and the criteria for the final selection.

ESP

For a comprehensive forecasting program little could be added to *ESP*, a software package on six disks (plus three tutorial disks) which has been adopted by Chase Econometrics as the software package they will deliver and supply to their customers for use with their *PC PLANR Workstation*.

The Econometrics Software Program, available only for the IBM, can read ASCII text files, DIF files, *Lotus 1-2-3* (WKS) files and Microsoft's Multitools (SYLK) files. Additionally, data from Chase Econometrics can be downloaded (using a communications package) in a form usable by *ESP*. The software uses the Intel 8087 math coprocessor, if installed, and supports all hard disks (including the XT disk).

While it is among the most expensive of the forecasting packages at $795, three characteristics set it apart from the competition:

- The ability to read virtually any type of data file, not just its own special configuration files. Files from any word processor (ASCII files) or almost any spreadsheet program like *Lotus 1-2-3* or *VisiCalc* (DIF files) can be used and data resident on a mainframe can be downloaded and used by *ESP* because of this feature (note that *ESP* does not include the software to actually perform the downloading function).
- Large databases or many different databases can be handled with ease and speed by using a hard disk. Calculation speed can also be increased with a math coprocessor chip (not included).
- *ESP* includes all the econometric tools forecasters are likely to use routinely: transformations, basic statistical functions, regression (many types), specialized forecasting techniques, graphics displays, and on-line help and tutorial functions.

ESP started its life as a mainframe package and is remarkably similar to *MicroTSP* in its format. The way in which commands are entered (and even some of the command names) are similar. Both use the command form of program control calling routines with one-word commands like SMPL 81M1 83M6 and OLSQ SALES PRICE ADVERT. Both *MicroTSP* and *ESP* are able to read a wide range of data file types as well.

ESP also includes on-line help, menus for various program sections, and a much more extensive graphic capability than *MicroTSP*. *ESP* can also use all forms of data: time-series, cross-sectional, vectors, and even matrices. Any data saved by *ESP* are recalled simply by referring to them by name.

How large a database can *ESP* handle? A large database with 75,000 observations on 500 variables will fit on a single disk and you can access up to 1000 variables at a time. For most people, in terms of capacity *ESP* will be like using a mainframe.

The *ESP* manual is not a statistics tutorial (i.e., it will not teach you how to forecast), but it is among the best of manuals for learning how to operate the soft-

ware with dexterity. Three tutorial disks are included and provide you with your first experiences on *ESP*. On-line tutorials provide a quick run through of most of the capabilities of the program (there are actually five different levels of on-line help; you use just what is appropriate).

Like *MicroTSP*, *ESP* can run "batch" jobs and save these run commands as a separate file allowing you to rerun routine projects with a single command. Perhaps you might update a forecast each week or month as new data become available—the batch mode is made for this type of use.

One of the most popular advanced forecasting techniques is specifically available in *ESP*: Box-Jenkins Time Series Analysis. The identification of a Box-Jenkins model is covered in the reference section of the manual.

Nuametrics/ Xtrapolator/ MicroBJ

Three separate software packages are produced by a company called Stratix. All three packages, which are available both for Apple II line and for the IBM- PC, are of interest to individuals interested in forecasting and business economics.

Xtrapolator performs trend analysis (regression where the independent variable is time or some transformation of time) in a variety of different forms. Each of the Stratix packages is more-or-less single purpose, and the purpose of *Xtrapolator* is to perform twelve distinct types of time series analysis: linear trend, moving average, exponential curve, Gompertz curve, geometric curve, double moving average, second order polynomial, exponential smoothing, third order polynomial, double exponential smoothing, autoregressive trend, and triple exponential smoothing.

Nuametrics is designed for those who wish to use regression (with up to seven independent variables) as the technique for forecasting. Both *Nuametrics* and *Xtrapolator* allow the transformation of variables, the use of DIF files (if those files have only a single column of numbers), and the creation of plots.

The final package from Stratix is *MicroBJ* which has as its sole task the estimation of Box-Jenkins time series models. These are forecasting models with time as the only independent variable that are estimated using a complex procedure developed by Box and Jenkins. The three program modules allow you to identify, estimate, and then forecast with the appropriate Box-Jenkins model. Plots are also available with this software. *MicroBJ*, however, will not read DIF files like its companion programs.

SPSS/PC

We have mentioned that certain packages look like SPSS on a mainframe, but the program which replicates the mainframe version almost perfectly is *SPSS/PC* itself. This is not a program for neophytes or individuals who don't have an IBM PC *fully* equipped. It is also not your program if you will be forecasting infrequently or always with the same technique.

But *SPSS/PC* is your program if you fall into any of these categories:

- Need a *complete* statistical package capable of a wide variety of analytical techniques and an infinite variety of transformations.
- Need to transfer data back and forth to a large mainframe program capable of handling huge datasets.
- Require complete plotting *and report writing capability.*
- Need the ability to handle up to 200 variables at once.

SPSS/PC requires the use of a hard disk, and it is strongly advised that you have the 8087 math coprocessor (available free to academic sites from Intel Corporation) installed in your IBM. It also requires 320K of memory.

Is it easy to use? It was very easy for me to use because I use SPSS on a mainframe quite frequently and the command structure is almost identical (the manual has a special section just for users of mainframe SPSSx to spell out the differences to them). It was quite a shock to realize that the very same capabilities we have on a large mainframe can now be had on a microcomputer (well, not exactly the same; there are limitations on the size of the dataset).

Will it be an easy system for new users to learn? That is a different question. The *SPSS/PC* command system takes a little getting used to. First-time users will require some time to learn the command system before becoming productive, but that same command type system has its advantages; namely, it is quite fast as a way of requesting specific analyses, and it is infinitely versatile in what it can request.

For any user (new or experienced) there is a complete help facility on-line which offers descriptions and examples of situations you may encounter. If you forget the variables you have in memory, a SHOW command is available, and if you forget the options you have in effect, a DISPLAY command will remind you.

Keep in mind, too, that *SPSS/PC* is also a report writer. That is, it has the capability of presenting the information you have analyzed in printed form according to any format you may desire. That can be quite a timesaver since you do not have to transfer any of the information, tables, or plots to another package to complete a report.

A special feature unique to *SPSS/PC* is the use of a portable file to transport your data and definitions between *SPSS/PC* and SPSSx on a mainframe without having to redefine them every time. An EXPORT command produces a portable ASCII file that can be read with the IMPORT command in *SPSS/PC* or mainframe SPSSx. You can upload EXPORT files to a mainframe using Kermit protocol (an error checking routine used on some mainframe systems) if both the mainframe and the IBM PC have Kermit installed.

A special feature unique to SPSS/PC is the use of a portable file to transport your data and definitions between SPSS/PC and SPSSx on a mainframe without having to redefine them every time.

SPSS/PC does *not* include a communications package to perform the uploading, but the manual advises the programs such as *Crosstalk* and *PC-Talk III* can transfer such ASCII files. Note that *SPSS/PC* files containing special graphics characters may not be transferred correctly to mainframes or to other types of personal computers.

It would be impossible to list all the procedures available in the program, but suffice it to say that there are few statistical procedures missing. While *SPSS/PC* is not sold as only a forecasting package, it could do quite well in that category while providing a powerful general statistics package and a report generator. ■

Business Forecasting Software

	VisiTrend/Plot	StatPro	TSP	Daisy	DSM	Graph N' Calc
Host Personal Computer	Apple/IBM	Apple/IBM	Apple/IBM	Apple	IBM	Apple III
User Interface	Menu	Menu	Command	Command/ Spreadsheet	Menu	Spreadsheet/ Menu
Calculate Descriptive Statistics	Yes	Yes	Yes	Yes	Yes	Yes
Regression/Trend Analysis						
Linear Regression	Yes	Yes	Yes	Yes	Yes	Yes
Non-linear Regression	Yes	Yes	Yes	Yes	Yes	Yes
Stepwise Regression	No	Yes	No	Yes	No	No
Time Series Analysis						
Moving Averages	Yes	Yes	No	No	Yes	No
Exponential	Yes	Yes	No	No	Yes	Yes
Polynomial Forecasting	Yes	Yes	Yes	Yes	Yes	Yes
Transform Data	Yes	Yes	Yes	Yes	Yes	Yes
Program can be Booted from Hard Disk	No	Only in Apple and IBM XT version	No	No	Yes	Yes
Prints Results	Yes	Yes	Yes	Yes	Yes	Yes
Display/Print Graphics	Yes/Yes	Yes/No	Yes/No	Yes/No	No/No	Yes/Yes
Number of Pages in Manual	187	383 (includes manual for graphics/data)	175	242	25	134 (extra forecasting text included)
Special System Requirements						
Suggested List Price	IBM-$99 Apple-$99	Apple-$795 IBM-$795	IBM-$395 Apple-$295	$199.95	$295	$195

Software Directory

VisiTrend/Plot

VisiCorp
2895 Zanker Rd.
San Jose, CA 95134
(408) 946-9000

Statpro

Wadsworth Professional Software
Statler Office Building
20 Park Plaza
Boston, MA 02116
(800) 322-2208
(617) 423-0420

MicroTSP

McGraw-Hill Book Company
Computer Science/College Division
1221 Avenue of the Americas
New York, NY 10020
(800) 782-3737
(212) 512-2000

Daisy Professional

Rainbow Computing, Inc.
8811 Amigo Ave.
Northridge, CA 91324
(818) 349-0300

DSM

Decision Systems Support, Inc.
31871 Via Puntero
San Juan Capistrano, CA 92675
(714) 493-3639

Graph N' Calc

Haba Systems
154 Stagg St.
Van Nuys, CA 91405
(818) 901-8828
(800) Hot-HABA

TK! Solver

Software Arts, Inc.
27 Mica Lane
Wellesley, MA 02180
(617) 237-4000

Expert Choice

Decision Support Software, Inc.
1300 Vincent Pl.
McLean, VA 22101
(703) 442-7900

SmartForecasts

Smart Software, Inc.
392 Concord Ave.
Belmont, MA 02178
(617) 489-2743

Comparison Chart

	TKI Solver	Expert Choice	Smart Forecasts	ESP	Nuametrics	Xtrapolator	MicroBJ	SPSS/PC
	Apple/IBM Macintosh	IBM	IBM	IBM	Apple/IBM	Apple/IBM	Apple/IBM	IBM
	Work sheets	Menu/Tree Format	Command	Command/ Menu	Menu	Menu	Menu	Command
	↑	↑	Yes	Yes	Yes	No	Yes	Yes
	Specialized equation solver only	Specialized decision aide based on using decision tree analysis	Yes Yes No	Yes Yes No	Yes Yes No	↑ Uses only time as the independent variable	↑ Specialized Box-Jenkins time series forecasting only	Yes Yes Yes
	↓	↓	Yes Yes No	Yes Yes Yes	No No Yes	↓	↓	Yes Yes Yes
	Yes	Yes	Yes	Yes	Yes			Yes
	No	No	No	Yes	Apple-No IBM-Yes	Apple-No IBM-Yes	Apple-No IBM-Yes	Required
	Yes Yes/Yes	Yes Yes/Yes	Yes Yes/Yes	Yes Yes/Yes	Yes Yes/No	Yes Yes/No	Yes Yes/No	Yes Yes/Yes
	470	243	190	451	11	18	43	619
	Apple version requires 128K							
	Apple-$299 IBM-$399 Macintosh-$249	$495	$495	$795	IBM-$195 Apple-$97.50	IBM-$195 Apple-$97.50	IBM-$295 Apple-$147.50	$795

ESP
Alpha Software Corporation
30 B St.
Burlington, MA 01803
(800) 451-1018
(800) 426-2016 (MA)

Nuametrics
Xtrapolator
MicroBJ
Stratix
P.O. Box 1014
Woodinville, WA 98072
(206) 821-1896

SPSS/PC
SPSS Inc.
444 North Michigan Ave. Ste. 3000
Chicago, IL 60611
(312) 329-2400

Framework
Ashton-Tate
10150 W. Jefferson Blvd.
Culver City, CA 90230
(213) 204-5570

Visi On
VisiCorp
2895 Zanker Rd.
San Jose, CA 95134
(408) 942-6000

Financial Planning for Lotus 1-2-3
Howard W. Sams & Co.
4300 W. 62nd St.
Indianapolis, IN 46264
(800) 428-3696

Open Access
Software Products International
10240 Sorrento Valley Rd.
San Diego, CA 92121
(619) 450-1526

Symphony, 1-2-3
Lotus Development Corporation
161 First St.
Cambridge, MA 02142
(617) 492-7171

Lisa 7/7 Office System
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

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WHAT'S NEW IN HARDWARE

Sperry Portable Computer

Sperry has unveiled the Sperry Portable Computer, an IBM PC compatible portable computer. It uses a 16-bit Intel 8088 microprocessor operating at 4.77 MHz; includes 256K RAM, expandable to 640K; and runs MS-DOS 2.11, an enhanced version of PC-DOS.

The Portable Computer comes with one 5.25", 360K floppy disk drive and has provision for a second floppy drive or a 10Mb hard disk drive. It has one parallel port, one RS-232C serial port, and four expansion slots. It supports an 8087 numeric co-processor and contains a built-in graphics board providing a resolution of 640 pixels x 400 pixels on the built-in 9" green screen monochrome monitor.

It includes a 110/220 volt power supply, suitable for use with U.S. and overseas power sources, that can switch between 60Hz and 50Hz. The dimensions are 16" x 20" x 9" and the computer weighs in at 38 pounds. The Sperry Portable Computer carries a base price of $2685.

Sperry Computer Systems
P.O. Box 500
Blue Bell, PA 19424
(215) 542-4213

CIRCLE **435** ON READER SERVICE CARD

Booster for IBM PCjr

Microsoft has introduced the PCjr Booster, an expansion card for the IBM PCjr with 128K RAM, a battery-operated clock/calendar, and mouse support. It also includes JBasic, a software enhancement to the IBM Basic cartridge that allows standard Basic programs to run up to 22 percent faster and provides twice as much screen memory.

The Booster without memory sells for $295; with memory, for $495. The Microsoft Serial Mouse with ColorPaint sells for $195.

Microsoft
10700 Northup Way
Bellevue, WA 98004
(206) 828-8080

CIRCLE **411** ON READER SERVICE CARD

Fat Mac

Apple Computer has introduced the Macintosh 512K, an upgraded version of the original Macintosh with 512K of internal memory. It uses 256K RAM chips to provide faster response time and increase file size.

The Macintosh 512K carries a suggested retail price of $3195. The entry level Macintosh with 128K sells for $2195. A Memory Expansion Kit to convert an entry level Macintosh to a Macintosh 512K costs $995.

Apple Computer
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

CIRCLE **412** ON READER SERVICE CARD

MultiMode Dot Matrix Printer

Qantex has announced the Model 7035, a bidirectional dot matrix printer operating at 180 cps in draft mode, 75 cps in near letter quality mode, and 37.5 cps in letter quality mode. It features dot addressable graphics and can store up to 43 fonts on-line, including international, scientific, and word processing character sets.

The 7035 includes Centronics parallel and RS-232 serial interfaces; contains a 4.7K buffer, expandable to 12.7K; and prints up to 256 columns. It also comes with a 115/240 volt power supply, suitable for use with U.S. and overseas power sources, that can switch between 60Hz and 50Hz. The 7035 carries a suggested retail price of $1695.

North Atlantic Industries
Qantex Div.
60 Plant Ave.
Hauppauge, NY 11788
(516) 582-6060

CIRCLE **413** ON READER SERVICE CARD

Dot Matrix Printers from Datasouth

Datasouth has unveiled the Personal Printer I and the Personal Printer II, both bidirectional dot matrix printers operating at 160 cps in draft mode and 27 cps in near letter quality mode. Both printers feature dot addressable graphics, pin and friction feed, nine international char-

acter sets, and a 2K buffer. A Centronics parallel interface is standard with an RS-232 serial interface available as an option.

The Personal Printer I has a 10" carriage, prints up to 80 columns at 10 pitch or 136 columns at 17 pitch, and sells for $695. The Personal Printer II has a 17" carriage, prints 156 columns at 10 pitch or 256 columns at 17 pitch, and sells for $895.

Datasouth Computer
4216 Stuart Andrew Blvd.
Charlotte, NC 28210
(704) 523-8500

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What every Apple owner should know about WORD JUGGLER™.

If you own an Apple IIe or IIc—or you're planning to buy one—here are a few things you should know about Quark's Word Juggler word processor.

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Plus, Word Juggler is the most easy-to-use professional word processor you can buy for your Apple. Virtually every function—even complicated "cut-and-paste" tasks—can be accomplished with a single keystroke.

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Fact is, no other word processor for your Apple IIe or IIc gives you this unique combination of power, functionality and ease of use. And if all these advantages aren't compelling enough, check the price. Suggested retail is only $189.

So visit your favorite dealer today. Ask for a complete demonstration—and for a copy of our brochure, "What Every Apple Owner Should Know About Word Juggler." If you don't have a favorite dealer, but would like one, just call 1 (800) 543-7711. We'll fix you up.

Quark INCORPORATED

2345 West Bayaud, Suite 230
Denver CO 80219

Quark and Word Juggler are trademarks of Quark Incorporated. Apple IIe is a registered trademark of Apple Computer, Inc.

Actual retail price may be lower. Educational version not available.

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Photography by Barbara Kinney

WHAT'S NEW IN HARDWARE

Color Monitors from Amdek

Amdek has released three color monitors, the 500, 700, and 710, for the IBM PC and compatibles, PC jr, Apple II and compatibles, and Atari computers. All three offer RGB or composite color.

The 500 provides text resolution of 25 lines x 80 columns and graphics resolution of 460 pixels x 240 pixels in RGB mode and 320 pixels x 240 pixels in composite mode.

The 700 offers text resolution of 25 lines x 96 columns and ultra-high graphics resolution of 720 pixels x 240 pixels. The 710 offers the same text resolution and graphics resolution of 720 pixels x 480 pixels.

The 500 carries a suggested retail price of $525. The 700 sells for $749, and the 710 retails for $799.

Amdek Corp.
2201 Lively Blvd.
Elk Grove Village, IL 60007
(312) 595-6890

CIRCLE **415** ON READER SERVICE CARD

Modems for IBM PC and Compatibles

Transend has announced the InfoPhone IPI-1200 internal modem and InfoPhone IPX-1200 external modem for the IBM PC and compatibles. Both feature 300/1200 baud transmission, auto-dial, auto-answer, automatic voice/data switching, Hayes compatibility, and pulse and touch-tone dialing. Both models are compatible with AT&T 103, 113, and 212A modems.

The IPI-1200 and IPX-1200 come bundled with Complete and Pipeline communications software and include free time on several popular telecommunications services. The IPI-1200 sells for $370, and the IPX-1200 for $445.

Transend Corp.
2190 Paragon Dr.
San Jose, CA 95131
(408) 946-7400

CIRCLE **416** ON READER SERVICE CARD

Voice Controlled Video Games

Arctec Systems has introduced Micro-Ear, a voice recognition and command system for IBM PC and Apple II series microcomputers. Micro-Ear plugs into an RS-232 serial port and comes complete with a microphone, 9-volt power supply, and user's guide. Micro-Ear acts on up to 256 words by storing voice patterns in memory.

Micro-Ear carries a suggested retail price of $579.

Arctec Systems
9104 Red Branch Rd.
Columbia, MD 21045
(301) 730-1237

CIRCLE **417** ON READER SERVICE CARD

Protection Devices

Our May 1984 issue contained a roundup of devices for power line protection. Since then, Curtis Manufacturing and SGL Waber have introduced new protection devices.

Curtis Manufacturing has launched a line of surge protectors dubbed Diamond, Ruby, Emerald, and Sapphire. Each has one main on/off switch, and the Sapphire and Ruby offer EMI-RFI filtering. Retail prices range from $49.95 to $89.95.

Curtis Manufacturing Inc.
305 Union St.
Peterborough, NH 03458
(603) 924-7803

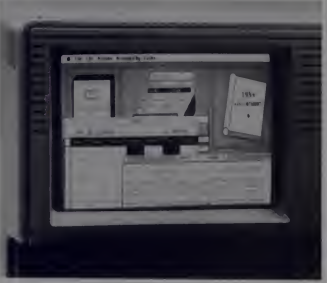
CIRCLE **418** ON READER SERVICE CARD

SGL Waber has released the Dataguard SST, a protection device with sequential surge timer with surge and noise suppressors. The Dataguard SST provides time-delayed start-up capability, contains a four-stage filter network to protect against voltage surges, and has a circuit breaker to guard against power overloads. The Dataguard SST retails for $199.

SGL Waber
300 Harvard Ave.
Westville, NJ 08903
(800) 257-8384 or
(609) 456-5400

CIRCLE **419** ON READER SERVICE CARD

WHAT'S NEW IN SOFTWARE



Office Management Software

Layered has introduced *The Layered System*, office management modules designed for dentists and physicians that run on the Apple Lisa and Macintosh computers. The first module, *Front Desk*, is an appointment scheduler that also tracks revenue and costs. It retails for $149.95.

The second module covers accounting procedures and is due out in January 1985. No price has been set. Both modules use windows and a mouse.

Layered
85 Merrimac St.
Boston, MA 02114
(617) 423-9041

CIRCLE **420** ON READER SERVICE CARD

Fundraising Software

GT National has introduced *Target/1 Fundraiser*, an integrated package containing database, accounting, and word processing functions for non-profit organizations. It requires *WordStar* and *MailMerge* to use the word processing capabilities fully.

Target/1 Fundraiser sells for $1195. Toll-free telephone support, newsletters, and enhancements cost $150 per year.

GT National Computer Software
400 Center St.
P.O. 3008
Auburn, ME 04210
(207) 786-0195

CIRCLE **421** ON READER SERVICE CARD

Spotlight on Software Arts

Software Arts has introduced *Spotlight*, an integrated desktop management program for the IBM PC. It features an electronic calendar, operating system filer, phone book, note pad, index card file, and calculator.

Spotlight resides in memory and is accessible while using other programs. It reserves 75K of RAM, so Software Arts recommends at least a 256K RAM computer system. It can be installed on a hard disk, and retails for $149.95.

Software Arts
27 Mica Ln.
Wellesley, MA 02181
(617) 237-4000

CIRCLE **422** ON READER SERVICE CARD

IBM Software for PC

IBM has released the Business Management Series and the Personal Decision series, a total of 31 integrated programs covering business accounting, training, and information management.

The accounting programs carry a suggested retail price of $695 each; the accounting training programs $95 each. Most Personal Decision programs run $150-$300, and the two accounting and financial bridge programs between the two series $245 each.

IBM, Entry Systems Group
P.O. Box 1328
Boca Raton, FL 33432
(305) 998-2000

CIRCLE **423** ON READER SERVICE CARD

The Data Factory from MicroLab

MicroLab has released *The Data Factory* version 6.0, an upgraded database program for the Apple II series. The new version contains a demonstration and tutorial disk.

The Data Factory allows up to 88 fields in a record and up to 239 characters per field. It requires 48K and two disk drives and carries a suggested retail price of $199.

MicroLab
2699 Skokie Valley Rd.
Highland Park, IL 60035
(312) 433-7550

CIRCLE **424** ON READER SERVICE CARD

Telecommunications Software from Hayes

Hayes Microcomputer Products has released *Smartcom II* version 2.0 for the IBM PC AT and the AT&T 6300 computers. It also runs on the TI Professional, Wang PC, HP 150, and DEC Rainbow 100. *Smartcom II* 2.0 adds VT 52 and VT 102/100 emulation and works with the internal Hayes Smartmodem 1200B and external Hayes Smartmodem 1200 modems.

Smartcom II 2.0 sells for $149. Owners can receive the upgrade for $25.

Hayes Microcomputer Products
5923 Peachtree Industrial Blvd.
Norcross, GA 30092
(404) 449-8791

CIRCLE **425** ON READER SERVICE CARD

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There's a notepad that has a full-screen editor that can time and date stamp your notes, and then save them to disk. You can even pull information into the notepad directly from the screen of your "underlying" software.

Suppose you're working in Lotus and the phone suddenly rings. Give your Sidekick a call and it pops right up over Lotus with the notepad you need. Or an appointment calendar . . . one you can never misplace.

What if you need to do a quick calculation? A keystroke instantly brings up the calculator. And the results of your calculations can even be transferred to your "underlying" software.

Need to make a phone call? Up pops your personal phone directory. Type in the name you want . . . and Sidekick jumps right to the phone number. Another keystroke, and the phone is automatically dialed for you.**

There's lots more, too. You can move the Sidekick windows anywhere on the screen you like. And you can have as many on screen at a time as you need. There's even an on-line help window for each of Sidekick's features.

We designed it because we needed it. If you've ever been writing a report and needed to do a quick calculation, or jot down a note, then you need Sidekick, too.

Here's Sidekick in action. That's Lotus 1-2-3 running underneath. In the Sidekick Notepad you can see data that's been imported from the Lotus screen. On the upper right, that's the Sidekick Calculator.

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WHAT'S NEW IN SOFTWARE

Spreadsheet for Atari

Micr(o)L(o)gix has introduced *CPA Spreadsheet*, an integrated spreadsheet and graphics package for Atari computers with 48K RAM. It uses Basic commands to program cells, allowing if/then logic, relational and Boolean operators, and algebraic and trigonometric functions. *CPA* sells for $99.95.

Micr(o)L(o)gix
P.O. Box 9608
Coral Springs, FL 33075
(305) 972-6762

CIRCLE **426** ON READER SERVICE CARD

Model 100 Software

Tandy has introduced *Business Finance*, a series of 12 financial analysis programs for the TRS-80 Model 100. Available modules calculate net present value, internal rate of return, depreciation, annuity, and portfolio analysis. *Business Finance* requires 16K RAM and retails for $39.95.

Available at Tandy/Radio Shack stores and Computer Centers.

TRS-80 Software

Gulf States Computer Services has released *Gulfpak I*, three utility programs for Basic programs running on TRS-80 Models I, II, III, 4, 12, and 16. Each utility executes from the overlay area of the operating system while the Basic program resides in memory.

Shrink compresses a Basic program into the smallest possible size without altering the logic or data within the program. Break assigns a separate line number to each Basic statement. Insert adds spaces into the program to make the listing easier to read. *Gulfpak I* sells for $49.95.

Gulf States Computer Services
10039 Bissonnet, Suite 130
Houston, TX 77036

CIRCLE **427** ON READER SERVICE CARD

Word Processor Update

In the December 1984 issue, we compiled a comparison chart of more than 100 word processors for our word processing special section. Since then, several other word processors have been released.

OSS has released *The Writer's Tool* for Atari computers. It features mail merge, underlining, super- and subscripts, headers, footers, multiple fonts, and left, right, and center justification. *The Writer's Tool* retails for $129.95.

Optimized Systems Software
1221-B Kentwood Ave.
San Jose, CA 95129
(408) 446-3099

CIRCLE **428** ON READER SERVICE CARD

Milliken Publishing has introduced *The Milliken Word Processor*, a word processor designed for students in grades three and up. It contains most word processing features and runs on the Apple II series computers. It retails for $69.95.

Milliken Publishing
1100 Research Blvd.
P.O. Box 21579
St. Louis, MO 63132
(314) 991-4220

CIRCLE **429** ON READER SERVICE CARD

Handic has introduced *Word Result*, a word processor for the IBM PC featuring underlining, super-and subscripts, search and replace, and boldface. It can tie in with the *Calc Result* spreadsheet. *Word Result* sells for $195; integrated with *Calc Result*, for $345.

Handic Software
520 Fellowship Rd.
Suite B206
Mt. Laurel, NJ 08054
(609) 866-1001

CIRCLE **430** ON READER SERVICE CARD

Rio Grande Software has announced *Wordpro*, a $199 word processor for the IBM PC and compatibles. It includes the features of *WordStar* as well as mail merge, a calculator, and foreign language capability.

Rio Grande Software
1107 Upas
McAllen, TX 78501
(512) 630-6979

CIRCLE **431** ON READER SERVICE CARD

Bonnie Blue has upgraded the *Bonnie Blue Word Processor* to use up to 640K RAM in an IBM PC. The previous version (see review in May 1984) had a memory limitation. The Full Memory version retails for $60.

Bonnie Blue Software
P.O. Box 536
Liverpool, NY 13088
(315) 652-1304

CIRCLE **432** ON READER SERVICE CARD

One computer under $1000 can run all these programs. And fly you into Chicago on a windy day.

The IBM PC*jr* can run so many programs, chances are you'll never find yourself up in the air.

Unless that's where you'd like to be.

More computer for your money.
See how PC*jr* compares with other computers at its price

Memory	**Software**
User Memory (RAM): 128KB (expandable to 512KB)	Runs over 1,000 programs written for the IBM PC
Permanent Memory (ROM): 64KB	Runs both diskette and cartridge programs
Diskette Drive	**Display**
Double-sided, double density	40- and 80-column
Capacity: 360KB	Resolution: 4-color: 640h x 200v 16-color: 320h x 200v
Processor	**Expandability**
16-bit 8088	Open architecture
Keyboard	Optional 128KB Memory Expanson Attachment(s)
Typewriter-style Detached, cordless	13 ports for add-ons, including built-in serial interface
Warranty	
1-year limited warranty	

You can use a PC*jr* to pilot your own aircraft with Flight Simulator. Or handle a business with the powerful Lotus™ 1-2-3,* in its new cartridge format. Or create full-color illustrations with the new PC*jr* ColorPaint.

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JOHN ANDERSON

NOTEBOOK COMPUTING

Model 100 disk drive, spreadsheet package, barcode generator, management software. NEC 8201 internal modem, Sharp peripherals

The year 1985 promises to be an exciting one for computers, not the least of which will be the portable machines. In no single subcategory of the microcomputer industry has technology moved at so swift a pace. Already the full-screen LCD has made an appearance, in machines such as the new portable from Data General. Advances in liquid crystal design and power requirements are making displays clearer and more readable. LCD color displays will make their retail debut this year. Their appearance in portable computers therefore cannot be too far off.

Breath is bated for a new entry from Tandy on the notebook computing scene, and rumors of a full-screen "Model 200" are rife for 1985. The ubiquitous Model 100 is now discounted to under $500, making it one of the best buys in computing today.

Matsushita has demonstrated small-scale projection TV, using separate guns and a pop-up rear projection screen, in prototype units weighing less than 10 lbs. There is good reason to suspect that the Japanese might experiment with this approach to portable color computing as well.

The Third Party Scene

While we wait for all these wild and wonderful developments, let's catch up with the current third party scene in notebook computing. There is quite a lot going on, so let's have a look.

Chipmunk Drive

Holmes Engineering of Murray, UT, has announced the Chipmunk, a 3.5" portable disk drive for the Radio Shack Model 100. The Chipmunk (so named because, according to the manufacturer, it is so "small and friendly") comes ready to plug into the Model 100—no software installation is necessary. Disk Basic and a powerful yet simple menu-driven operating system are included. Power is provided by built-in rechargeable batteries, or an AC adaptor. The unit fits easily into a briefcase, along with the computer itself. Additional drives may be chained to the Chipmunk for multidrive capacity. The unit sells for $550, including all connecting cables, manuals, and master disk.

Lucid Spreadsheet

Portable Computer Support Group, the first third party company to release software for the Model 100, has finally added a spreadsheet to its line. *Lucid*, a ROM cartridge that snaps into the ROM compartment on the back of the Model 100, offers a remarkable set of features. It takes no memory to load and no memory for operating overhead. It will let you build a very large spreadsheet —255 rows by 126 columns—while expending no memory on empty cells. This lets you use a 32K Model 100 to build spreadsheets that would consume 80 to 100K on a desktop computer. And it is fast.

Lucid has features that you can't find even in desktop spreadsheets. Cut, copy, and paste, for example, work within *Lucid* exactly as they do in Text. This makes manipulation of cell statements easy. Lucid takes all the formulas with it when you cut, and when you paste they all recalculate automatically with the entire sheet.

In addition, you can copy or cut from one spreadsheet to another spreadsheet or even from a Text file.

The program supports all Basic math functions as well as log, sine, cosine, tangent, exponentiation, and other sophisticated math functions. *Lucid* has expanded GOTO functions that remember and produce a windowing capability. It also has a special block definition capacity that makes possible other features that refer to whatever section of the spreadsheet you designate.

Lucid is not only a spreadsheet program, but a program generator as well. You can protect all cells against entry or change, and unprotect just the cells you wish to designate as input fields. You can construct screen instructions, and then prompt for input. *Lucid* will process not only values, but text input as well. The program can refer to cells containing words and check user input against look-up tables. If-then branching can move you through a complicated survey process effortlessly.

The ROM cartridge is priced at $150.

QuickType lets you define abbreviations one to three characters long for commonly used words, phrases, sentences, and paragraphs.

QuickType Macros

PocketInfo Corp., a developer and marketer of software for handheld and lap computers, has introduced *QuickType*, a program that speeds typing on the Radio Shack Model 100 and NEC 8201 lap computers.

QuickType lets you define abbreviations one to three characters long for commonly used words, phrases, sentences, and paragraphs, providing a sort of "personal shorthand." The computer stores as many abbreviations as are needed, speeding input time by reducing the number of needed keystrokes. The program is a boon for those who often use standard phrases, sentences, or paragraphs in their writing.

After typing a text file with the abbreviations, you run *QuickType* to expand the abbreviations into the correct full forms, producing a finished document for printing or transmission. You can create abbreviations on the fly, while typing, for later definition. This is especially valuable when repetitious

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phrases are discovered in the middle of a task.

QuickType comes on cassette and is priced at $30.

NEC Internal Modem

The major difference between the Radio Shack Model 100 and the NEC 8201 has up until now been the fact that the NEC machine does not sport an internal modem. But TouchBase Designs of Los Angeles has changed all that. They are offering a completely self-contained CMOS modem for the 8201 that installs in minutes without soldering or modification to your existing machine.

The Traveling Expense Manager allows you to stop wrestling with your company expense reports.

The TouchBase Design Modem is a compact (2" x 2") 300 baud modem card that installs inside the NEC portable computer. It does not interfere in any way with the normal operation of the computer or its ports. A special RS-232 connector cable interfaces the computer with the telephone line (a loop-through is provided so that a telephone can remain simultaneously connected to the modem circuit).

To install the unit, you must open the NEC case, removing four screws. While the top and bottom covers lie apart, side by side, the modem is laid inside, and six small clips are attached to clearly visible and reachable points. The only necessary tools are a small Phillips head screwdriver and a wire cutter/stripper.

The TouchBase Modem retails for $99 assembled. A similar unit is also available for the Epson HX-20.

Model 100 Barcode

Optical Data Systems Inc. has announced the introduction of a barcode print-generator program called *Strype Byte 100*, for the Radio Shack Model 100 computer. Now the Model 100 can not only read bar code, but generate it as well.

Intended for use on a good quality dot-matrix printer, *Strype Byte* supports all three bar codes that the Model 100 can read: UPC-A, Code 3 of 9, and Modified Plessey. Bar codes can be produced in single or multiple copies, either randomly or sequentially, on labels or forms. The program allows you to design the format of a printout, including size, alphanumeric header, and positioning.

Encoding programs are entirely in machine language, with control programs in Basic to facilitate customization. You are guided by menu-driven options throughout.

Strype Byte 100 is available on cassette or DVI format disk for $50.

Traveling Software

Did you hear the one about the traveling salesman? He needs the power of a desktop packed into his Model 100, NEC 8201, or Olivetti M-10. Seven new programs from Traveling Software have come very close to granting his wish.

The Traveling Appointment Manager provides an easy-to-use, efficient way to keep track of business and personal appointments. It takes advantage of the clock and calendar built into your computer to log appointments and remind you later where you should be and when. You can even reschedule recurring appointments automatically. An accompanying program, Things-to-Do Manager, allows you to keep a list of things to accomplish, in the priority you wish to accomplish them. Priced at $60.

The Traveling Sales Manager keeps not only a detailed log of your customers and contacts, but also a full record of what each customer purchased and when. It allows you to store important biographical data and notes about your customers. The program will even remind you to contact a customer on a particular date with a comment as to the nature of the contact.

You can also produce a variety of printed reports to: summarize all your data, give you instant access to information about customers, or list specific information by specific label. Priced at $60.

The Traveling Expense Manager allows you to stop wrestling with your company expense reports. You start by defining your expense categories and then, whenever they occur, record your expenses and designate which account they are to be charged to. You will see on-screen reports showing your current balances for each account and cumulative expenses for all projects or clients. You can produce printed reports for time periods you specify, by client, project, or expense category. Priced at $60.

The Traveling Writer puts the capabilities of a desktop text formatter into your notebook machine. It allows you to format files you have created using Text and design the way the type will look on the printed page. You can set left, right, top, and bottom margins; set line spacing; choose justified or proportional text; create tabulated printouts; print headers and/or footers; print underlines, italics, and boldface; and specify mail merge functions. Priced at $50.

The Traveling Time Manager can be used as a complete professional time accounting and billing system. Time expenditures can be recorded automatically or manually for projects or clients and categorized by type of work activity. Time expenditures may also be identi-

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The Traveling Project Manager can be used to manage small or large projects using a unique summary feature to track project expenditures over an extended period. You can manage several projects at the same time using work activities and tasks you define. Estimated and actual detailed expenses may be recorded as well as estimated and actual activity/task start and end dates. A variety of summaries and printed reports can be generated, including a project schedule bar chart; budget vs. actual, project, activity, and task dollar or unit expenditures; and percentage completion report by activity and task. Priced at $60.

T-Base is a relational database software product, designed specifically for the Model 100, NEC 8201, and Olivetti

Competition Heating Up

Who will be the winner in the low-end notebook portable market? We're wagering it will not be Sord. Despite having a nifty machine with several interesting pieces of software, Sord just doesn't have the distribution channels to take advantage of an excellent product.

How about Epson? Their HX-20 turned out to be a less-than-sparkling performer mainly because of its 20-character x 4-line display. Epson has salvaged the machine from total disaster by selling it to OEMs who add software and sell it as a dedicated machine for narrow categories of end users. The PX-8 Geneva? I don't think much of the CP/M operating system, but people at Epson tell me that software houses like the idea of an operating system—however archaic—better than Basic (as found in the HX-20 and Model 100). But will the PX-8 make it? Distribution is the key. If Epson can convince their powerful printer distributor/retailer force to handle the computer, they may do well. But, I'd bet their reception will be lukewarm, as will their success with the PX-8.

The lower-capability Epson machine just introduced in Japan (40-column screen) is aimed strictly at the OEM market and is unlikely to be a major factor in the end-user market. Too bad; it might have done well.

How about the Tandy Model 100? All reports indicate it is about to be phased out (or at least into the background). When Tandy starts cutting prices as drastically as they have on the Model 100, people start to suspect that they're anticipating the machine will be replaced or retired. So, will the Model 200 be the new winner? Maybe. Like the Model 100 it is from Kyocera (Kyoto Ceramics in Japan); it has a larger display (80 characters x 8 lines at last report) and more memory—perhaps even a quieter keyboard—but it is not a breakthrough of any sort.

NEC—their 8201 held to about a 10% market share by Radio Shack's powerful chain of 8000+ stores—is out for blood with their new PC-8401 portable. The machine has a fold-up, 80-character by 16-line display and substantially improved performance, yet sells for around $1000. From an early preview, I would give the 8401 a performance score of 60 to 65 (see January 1984 issue)—over 50% higher than the 8201/Model 100.

However, I wouldn't lay money on NEC being able to obtain widespread distribution for the 8401, so despite the excellence of the product, I'm not sanguine about its success. (Incidentally, the folks in Tokyo are not unaware of the problems of a divided company—the APC and printers from one division and notebook computers and displays from another—but they have no immediate prospect of solving the dilemma.)

At the upper end of the market things have not developed nearly as quickly as many manufacturers had anticipated (or hoped). Gavilan is in Chapter 11. The HP Portable (110) is not exactly leaping off dealer shelves, and Sharp's PC-5000 is suffering from a massive case of apathy (and personnel changes at Sharp). There is a great deal of excitement about the Data General One, but the jury is out as to whether it will be able to generate sustained sales. At this point, I wouldn't want to bet my company on it.

The Australian-built Dulmont Magnum (distributed by Teleram in the U.S.) is a possible contender, but foreign machines seem to have a tough time getting a real foothold in the U.S. no matter how good they are.

The Morrow Pivot (made by Vadim), also to be sold under the Osborne label as the Encore, also has a chance—but just barely. Why? Because of the limited distribution of Morrow and the shakey image of Osborne.

My pick of the winners? In the low end, Tandy/Radio Shack—just because of their enormous distribution. NEC in second place because they have a great product at an attractive price. But Epson also could be a major player—distribution is the key.

At the upper end? The winner will be Data General because they're feisty and have a technological winner of a product (incidentally, the 80-character x 25-line display is made by Epson). Second place will go to HP and a distant third will go to Sharp (because of miserable marketing).

Incidentally, keep an eye out for the Hellen portable from Fujitsu. It is similar to the Data General One (80 char x 25 line display) and is an IBM compatible unit. Priced under $2000, it could be a major contender.

Also watch for a new Kaypro portable from Sanyo. Sanyo is in the second tier of electronic manufacturers in Japan—they are generally thought of as a "price brand." Sanyo has not achieved a major position in the computer market and is anxious to do so; hence this move is important for both Sanyo and Kaypro (who desperately need a new, exciting product).

(An unrelated aside: currently Sanyo is one of three manufacturers—the others are Sharp and Epson—to have developed large color LCD displays (four-inch and larger). Currently suitable for only television use, displays for computer use should be coming along within a year.)

Stay tuned.

—DHA

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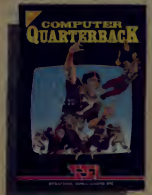

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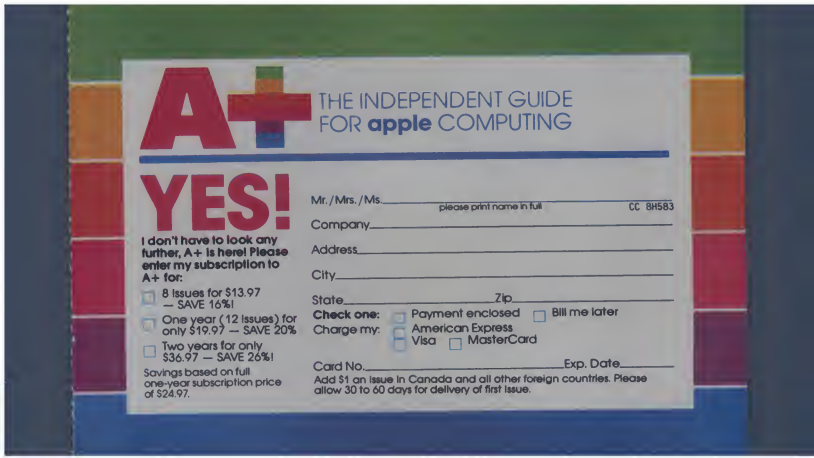
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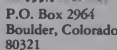

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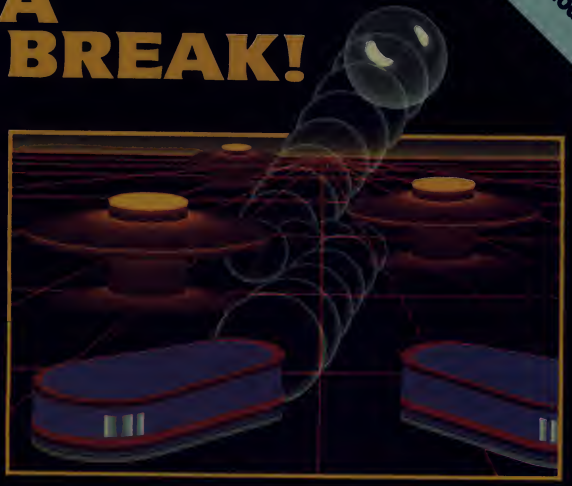

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Sharp Update

One year ago, in the January 1984 issue of *Creative Computing*, Dave Ahl reviewed the Sharp PC-5000 notebook portable. He was singularly enthusiastic, calling it "a full-capability, 16-bit desktop computer in a compact package." Well we remain enthusiastic about the machine, especially now that we have noticed it advertised at $1295 by New York discounters. That buys you a 128K MS-DOS compatible notebook machine with a fold-up 80-column x 8-line display and word processing/telecommunications programs in ROM. An optional inboard printer fits right into the body of the computer and provides 37 cps 80-column dot matrix hard copy. Also optional are a direct-connect modem/telephone and state-of-the-art bubble memory cartridges.

Now Sharp has introduced the CE-513 portable floppy disk drive. This AC or battery powered 3.5" Sony format disk drive can store 360K per double sided, double density disk. The unit weighs less than 6 lbs and measures 5.5" x 9" x 2.5". That is portable, indeed. The unit lists for $699.

On the handheld scene, Sharp also has three new product debuts. The PC-1260 Pocket Computer features 4.4K of RAM, a 24-column x 2-line display, and built-in Basic for a list price of $129. If you need more memory, you can vie for the PC-1261, which packs a walloping 10K into the same diminutive size (5.5" x 2.75" x 0.4",0.25 lbs). The PC-1261 lists for $195.

If a larger display is preferable, try the PC-1350 on for size. It provides four lines of 24 columns and 5K of RAM, expandable to 21K. Optional battery powered, credit card sized RAM cards are non-volatile, meaning they can be plugged in and out without altering their contents. Using the built-in serial interface, a PC-1350 can upload and download between itself and a PC-5000.

We hope to provide a full review of the PC-1350 in an upcoming issue.

Well, that's it for this go-round. Keep your batteries charged and maximum RAM free. See you next time. ■

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PRINT ABOUT PRINTERS

Amdek 5025, Genicom 3184, and Some New Year's Resolutions

The Amdek 5025 printer.

January. The first month of a new year. A time to look back on last year's accomplishments, and a chance to resolve to do better during the coming months. In that vein I examine two 1984 model printers, the Amdek 5025 and the Genicom 3184. To start the column off on the right foot, I make several resolutions that printer manufacturers can feel free to adopt as their own without fear of violating our copyrights.

Every so often I like to play a game called "Let's Pretend." This month I am pretending to be a big-shot printer manufacturer making his New Year's resolutions. You can play along at home. All you must do is slide back into a big overstuffed chair, pour a cup or glass of your favorite beverage and call your secretary in to take dictation. There, are you all set? Good, let's begin.

I Resolve To:

1. Provide my customers access to free technical support via a toll-free 800 number. In addition to answering their phones, the knowledgeable and friendly staff will actually return your call if they can't solve your problem right away.

2. Write manuals that computer novices can understand. The documentation will be illustrated with technical drawings and clear photographs. Instead of printing incomprehensible charts and tables, explanations and examples will accompany any confusing subjects. Most important, the manual will be professionally typeset, not simply photocopied from the hardware designer's notebook.

3. Build printers that accept standard cartridge ribbons, and where applicable, cartridge printwheels.

4. Include both a Centronics parallel port and an RS-232C serial interface so that my printers will be compatible with every home computer. If I feel especially benevolent, I might even provide the proper cables for several of the more popular machines.

5. Put parameter-setting DIP switches in easily-accessible locations.

6. Design printers with variable-width tractor and friction feed mechanisms. Furthermore, these devices will be positioned in such a way that you wouldn't be forced to advance a full sheet of blank paper to remove the last printed document page cleanly.

7. Include an un-retouched sample printout in all ads, literature, and press releases concerning the printer in question.

Oh, I know it is easy to tell the professionals what they are doing wrong, especially since I needn't worry about the economic feasibility of what I propose. All I am really asking is that printer manufacturers make it easier for users to install and operate their new computer peripherals. If you have any printer pet peeves, fire off a letter to the manufacturer, and send a copy to me. I'm interested in what you have to say.

Amdek 5025

First up for review this month is the Amdek 5025 daisywheel printer. Whereas the Star Micronics PowerType daisywheel printer I reviewed last month was intended to be used at home, the Amdek 5025 is aimed at the small business market.

The Amdek 5025 is 6.7" high, 24.4" wide, and 13.3" deep. The unit weighs in at a hefty 24.3 pounds. Some of this weight can be attributed to the extra foam insulation that provides excellent noise reduction. One of the major claims to fame of the Amdek 5025 is that it is very quiet for a daisywheel printer (50dB). In fact, when the printer is sit-

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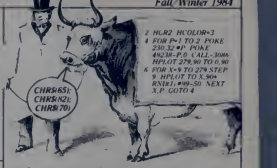
2 HGR2 HCOLOR=3
4 FOR P=1 TO 2 POKE 230,32 #: POKE 49236-P,0 : CALL -3086
MYLOT 279,80 TO 0,80
6 FOR X=8 TO 279 STEP 9: MYLOT TO X,96+RND(1)*99-50 NEXT X,P GOTO 4
CHR$(65): CHR$(92): CHR$(70)

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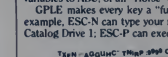

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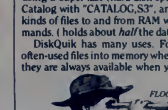

*5 INVERSE: PRINT SPC(7): A=A+1-3*A/A-3)*
8 POKE 2053,A+156: B=B+1: IF BC143 THEN 5

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X: 10 20 3000 & displays line numbers of
Y: 5 40 55 60 each variable & string.

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ting idle it is virtually silent. This is an important characteristic of any printer to be used in an office setting.

On the back of the 5025 is a female Centronics connector for interfacing to a parallel bus. Supplied with the printer is a custom cable with a male Centronics connector on one end and a male DB-25 at the other. This cable underscores the notion that the Amdek 5025 is designed to be used with an IBM PC.

Typical of most daisywheel printers, the 5025 does not come with a tractor feed mechanism standard. Instead, it relies on friction feed to load single sheets of paper. Both sprocket and sheet feeders are available as optional retrofits. The Amdek 5025 can handle forms up to five-ply and 16.5" wide. In addition, the 5025 features an external program mode (EPM) to control printing pressure according to the font used.

On the front righthand side of the unit is the control panel with its myriad lights and buttons. The typical control features—line/form feed, reset, on/off line, and set top of form—are available on this touch-sensitive panel labeled with both icons and words. Flip up the hinged cover and you find two DIP switches directly behind the control panel. All printers should have their switches so conveniently located.

The Amdek 5025 hums along quietly at 25 characters per second (cps), which is about average for most reasonably-priced daisywheel printers. Unfortunately, the actual throughput of the 5025 is somewhat slow due to the paper advance mechanism with a line resolution of 1/48 on an inch. Not only does the 5025 print bi-directionally, but you can also advance and reverse the paper at will. This feature is especially helpful when working on forms that require precise alignment.

The Amdek 5025 gets high marks for ease of operation. Both the multistrike ribbon and the printwheels come in cartridges that pop right into place with little fuss. Also, although it was not designed specifically for fan-fold paper, the 5025 can accept it and successfully prints page after page without "eating" the output or working its way out of alignment—two common problems with continuous feed paper.

The Amdek 5025 is an excellent printer for the money ($899), but low cost does not justify a poor manual. First of all, the documentation comes shrink-wrapped in plastic because it is not bound—not even stapled together. Apparently Amdek presumes that all 5025 buyers own IBM PCs and can simply throw these loose pages into one of those nifty little three-ring binders that come with the PC.

A far worse problem is that the information in the manual is inconsistent. Some subjects are so thoroughly covered that even a neophyte can understand them. Then you flip the page and find a schematic of the interface circuits with no explanations. Enough moaning. Amdek, polish your manual, and the 5025 will be an excellent addition to any computer system, though it looks particularly attractive sitting next to an IBM PC.

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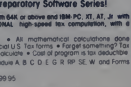

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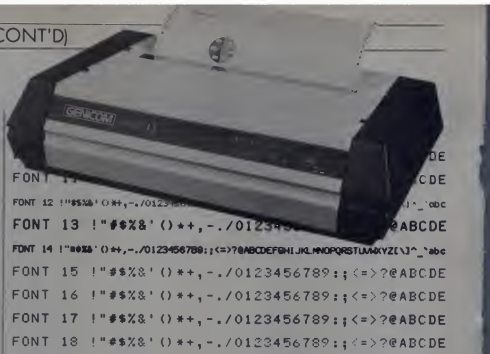

The Genicom 3184 color dot-matrix printer looks exactly like its brother pictured here, the 3404.

Genicom 3184

Genicom gets my vote for the best slogan I have seen in a while: "The new company you've been doing business with for years." You see, Genicom was once a division of General Electric. You know, GE, the folks that make refrigerators, stoves, washing machines, and the like. Given this background, it should come as no surprise that the Genicom printers look more like small appliances than computer peripherals.

Genicom sent us two printers: models 3404 and 3184. These printers are almost identical in size, features, and shape. However, I chose to review the 3184 because it offers color printing. With this exception, the two units can be thought of as twins, though the 3404 has an appreciably faster print rate.

As I have indicated, with its cumbersome 6.25" x 25" x 16" dimensions and black and white case, the Genicom 3184 looks like an industrial-strength appliance. Both its appearance and price make the 3184 better suited for the lab than the home. The 3000 series printers from Genicom are big, bulky, and built to take whatever you dish out.

Paper is fed into the 3184 from the back. Like most wide-carriage printers with adjustable tractors, the 3184 can use the entire range of paper available. Also, it can handle six-part forms, as long as the paper weight does not exceed 12 lbs. The 3184 is capable of printing on single sheets of paper, but not without a fair amount of difficulty.

As I mentioned, the Genicom 3184 is a color printer. That means that you can move the ribbon up and down via software control codes. The multi-strike ribbons are of the spool variety familiar to users of manual typewriters. The color ribbons are divided into four horizontal bands, each of a different color. To print red, for example, the computer must send the printer the code that will place the red strip of ribbon in front of the printhead. To print a color that is not one of the four on the ribbon, colors must be mixed. Genicom offers a variety of ribbons, each with a different set of colors.

The Genicom 3184 has two print speeds: 180 cps in draft mode and 45 cps in dual pass near-letter-quality mode. Even though this should be fast enough for most applications, there is a 512-character buffer to handle any overflow. In draft mode, characters are five dots wide, compared to nine dots wide in NLQ. The pitch, or number of characters per inch, can be set from normal 9.6 cpi to micro 18.0 cpi. And yes, the 3184 is capable of producing dot-addressable graphics using its nine-wire printhead. Thanks to multi-pass printing, the 3184 can stuff 144 dots into one horizontal inch!

By all rights the Genicom printers should be the healthiest on the market. Included in the front cover of the owner's manual is a test report generated at the Genicom lab in Waynesboro, VA, just before the unit was put into the box. Not only does this insure that the unit passed its burn-in phase at the factory, but it provides a sample of all the possible font styles, colors, and sizes. In addition to the factory test, the 3184 has its own built-in self-test which can be invoked from software or the program panel on the front of the printer.

In place of the standard push-buttons found on most printers, the Genicom 3184 control panel sports ten buttons and a two-character alphanumeric display. This display is multifunctional. It provides the operator visual feedback of printer status, fault conditions, set-up cues, and diagnostics information. Thanks to a menu-driven configuration feature, setting up the 3184 couldn't be easier. In fact, the control panel eliminates the need to set DIP switches manually.

The Genicom 3184 comes with an RS-232 serial interface and an optional Centronics parallel port on the rear of the unit. Both interfaces receive great attention in the documentation. The manual was written for a computer user, not a consumer. Given the target market of the 3184, the documentation couldn't be better. Designed in a logical and understandable fashion, the manual contains every piece of information a techie could want.

I tip my hat to Genicom. The Genicom 3184 is not a pretty machine, but I grew to love it for its features and durability. I am, however, disappointed with the size of the buffer, though a 6K buffer is available as a $80 option. Luckily, the 3184 has enough redeeming qualities that I recommend it if you are looking for a color printer that is built to withstand the rigors of extended everyday usage.

CIRCLE **434** ON READER SERVICE CARD

Well, that's it for this month. Don't forget to check the New Products section for even more printer news. Enjoy the rest of the issue and the New Year ahead. Cheers. ■

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APPLE CART

The 16-bit Apple IIx; Apples On-Line

It was just one year ago that Apple Computer introduced its revered Macintosh computer, and as the highly stylistic television ad with the female hammer thrower promised, saved the world from the Orwellian vision of 1984.

Indeed, Apple did change the public's perception of what a computer should be. They cast asunder the vision of a monitor perched precariously upon a clunky metal box with wires entangled like snakes in Indiana Jones's worst nightmares. Once the exclusive property of nerds with slide rules and plastic pocket protectors, computers suddenly became chic — fashionable. Cocktail party conversation centered on the attractive new computers coming out of Cupertino, and predictably the Macintosh became America's most expensive impulse purchase.

1984 is behind us now, and I suppose we all owe Apple a hearty thank you for saving us from the tyrannical Big Brother. Let us not dwell on the past, but rather, let us look toward the future and attempt to see what it holds for the computer world.

Apple II, Forever?

Apple introduced two new computers in 1984, the Macintosh and the IIc. The question is "how can Apple top these two impressive acts?" While rumors abound that third-party developers have been given color versions of Mac (and that Asian knock-off firms are poised to ship $1000 Mac clones to the States), a more credible rumor is that Apple is about to give birth to a new member of the Apple II family of computers, code name: IIx.

The technology around which the IIc is built is eight years old, which equates to several generations in the fast-paced world of personal computers. Thus, it came as a surprise to industry observers when Apple announced the IIc at a lavish introduction, the theme of which was "Apple II Forever."

With the introduction of the Apple IIc, the company made it clear that the II line of computers was their bread and butter and that they had no intention of abandoning this tried and true family of machines. Unlike Commodore, which seems to have no qualms about introducing a new, incompatible computer each year, Apple has never made a computer obsolete. Unless you count their competitors' computers that is.

Apple's next home computer must retain a high degree of compatibility with the II, while at the same time making significant strides in technology.

Apple's next home computer must retain a high degree of compatibility with the II, while at the same time making significant strides in technology. At first this may seem like a paradox, but the key to the puzzle may be an unassuming package of etched silicon encased in a chunk of black plastic bearing the numbers 65816.

The 65816 is a 16-bit CMOS (complementary metal-oxide semiconductor) version of the classic 6502 microprocessor that is at the heart of the Apple II. Stated quite simply, the 65816 is pin- and software-compatible with the 6502 when in 8-bit emulation mode, yet the toggling of a single flag bit is akin to throwing the throttle of a BMW motorcycle wide open and bursting into the realm of 16-bit processors.

Along with the greatly increased clock rate of this 8/16-bit CPU, more memory is addressable. While the 6502 can directly access only 64K bytes of memory, the 65816 has the ability to access a full 16Mb of memory. Though critics protest that with the availability of such vast expanses of memory, clean, efficient code will become a thing of the past, you cannot escape the fact that the availability of large quantities of inexpensive memory opens new doors to programmers with big ideas.

Since the 65816 can emulate the 6502, programs written for the latter require no modifications. Not content with simple compatibility, however, the engineers at Western Design Centers enhanced the 6502 instruction set, added new addressing modes and expanded interrupt handling.

In theory the 65816 is entirely pin- and software-compatible with the 6502 and could actually be used in existing systems with little or no additional support hardware. While it is unlikely that Apple will offer upgrades for the old II computers, the IIx will probably incor-

porate the 65816 along with the 256K memory chips that delayed the introduction of the Fat (512K) Mac.

My guess is that the IIx will come standard with 512K of RAM, with provision for generous memory upgrades.

It is Apple's contention that the Sony 3.5" disk drives like those used in the Mac will soon become the industry standard and that 5.25" floppies will fade from memory as did the 8" dinosaurs of yesteryear. Frankly, I look forward to a day when the rigid 3.5" diskettes replace their floppy ancestors. However, to maintain compatibility of format with the II line, 5.25" drives are a must for the IIx computer. What is the use of software compatibility if you can't easily load the old program disks?

It is Apple's contention that the Sony 3.5" disk drives like those used in the Mac will soon become the industry standard.

It is unlikely that Apple will introduce the IIx during the first quarter of 1985. They don't want to alienate the thousands of you who received IIe's and IIc's during the holiday season. It would be my bet that the date of introduction of this mystery computer rests entirely upon the sales performance of the rest of the II line.

Apple doesn't want a repeat of the embarrassing situation that followed the introduction of the IIc: instead of the IIc cutting into the sales of the IIe, the reverse happened. Shoppers were drawn into computer showrooms by the IIc marketing, but took home IIe's when they saw the lower pricetag. Obviously the public is not as afraid of slots as Apple had anticipated, which brings me to my next point.

The slotless IIc was supposed to attract home and educational buyers with its sleek design and user-friendliness. The IIe was to be the productivity tool of professionals and more advanced computer users. Somewhere between marketing and market, the product positions blurred.

I will now crawl out on a limb and predict that the IIx will replace the IIe. The IIc will remain Apple's home computer, while the IIx fills the gap between the IIc and the Mac. Retain the slots that have given the IIe its tremendous staying power and add the increased memory capacity and faster clock of the 16-bit 65816 and you have a machine perfectly suited for business users and hardcore computerists.

So there you have it; my predictions on the next Apple computer, the IIx. To recap, it will be based upon the 16-bit 65816 central processing unit, come standard with 512K of RAM, and use a half-height 5.25" floppy disk drive—and it *will* have slots. As far as the design of the case, that will be dictated by the hardware used in the IIx. I suspect the IIx will look like a cross between the IIc and the IIe, but of course I may be wrong.

Our On-Line Edition

If your Apple is equipped with a modem, I invite you to join the editors of *Creative Computing* on our very own CompuServe Special Interst Group (SIG). The CompuServe computer network is the largest telecommunications information system of its kind, and the *Creative Computing* SIG is fast becoming one of its most popular services.

In addition to the electronic mall which allows you to shop from your home via modem, there is a variety of user groups, message boards, and databases available on the CompuServe network. All it takes is a valid password (and checking account or credit card) to access this plethora of on-line information.

Connect fees depend upon when you log-on to the system, as well as what speed modem you use (300 or 1200 baud). CompuServe has local area access modes all over the United States which allow you to connect your computer without incurring outrageous long distance telephone bills. This is considerate, since once you get addicted to CompuServe you may find yourself logged on for hours at a time.

The Creative Computing SIG can be thought of as an on-line electronic edition of the magazine.

The *Creative Computing* SIG is located on page 22 of the computer information systems section of CompuServe. To visit, simply type GO PCS22 at any function prompt. When you arrive you will be asked to sign up as a new member (membership on our SIG is free and open to all) and then be given a brief introduction to the SIG.

The *Creative Computing* SIG can be thought of as an on-line electronic edition of the magazine. Special sections correspond to columns and features of the printed magazine, and there is original material as well. In addition to the constantly changing message board where questions are answered and news flashes posted, each section has its XA database which is similar to a large filing cabinet containing articles, reviews, and programs printed in the magazine. There is no need to spend hours manually entering program listings from the magazine; simply get on-line and pull the programs up into your computer buffer!

One of the most compelling reasons to climb aboard our SIG is that you get to converse directly with us, the editors of *Creative Computing*. Have a question that needs a prompt reply? Leave us a message or catch us in the Conference Center, and we will be glad to respond. In addition to making ourselves available, we have a bevy of industry celebrities lined up for special Conference Nights.

Associate Editor John Anderson has been acting as wizard system-operator (wiz sysop) ever since our official opening to the public several months ago. It is an enormous task for one fellow, but John perseveres and has managed, along with the regular members, to give the SIG a personality that is up-beat, humorous, interesting, informative, and above all, entertaining. Do drop by and visit often.

To counter the preceding unabashedly blatant plug for our own SIG, let me also tell you about the Apple-only SIG called MAUG (Micronet Apple Users Group). Neil Shapiro, the MAUG sysop, is to be commended for running one of the largest and most informative Apple computer bulletin boards ever.

There are literally thousands of programs, messages, and users on MAUG, and Neil keeps everything operating smoothly, while still managing to take time out to help the computer neophyte solve a problem. MAUG is an invaluable Apple resource and can be accessed by typing GO PCS51 at a function prompt. Tell Neil that Owen sent you. (Well, that's all for this month. We survived 1984 and on behalf of the staff of *Creative Computing*, I would like to extend to you our best wishes for a very happy 1985. ■

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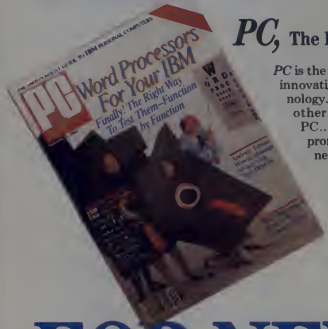

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SUSAN GLINERT-COLE

IBM IMAGES

Trivia, Flight Simulator, and Renaming a Subdirectory

Zoooooommmmmmm . . . It's faster than a speeding bullet, more powerful than a locomotive, bigger than a breadbox, it's. . . it's. . . the PC/AT. This machine is an acknowledged advancement in personal computer technology and as such, is a departure from the normal IBM conservative style.

Computer enthusiasts who enjoy watching a machine leave figurative skid marks when put into gear will derive considerable pleasure from the AT. Its housing has a bigger footprint (tire marks?) than the original PC, but the sacrifice of space is worth it. The prices are phenomenally competitive—another unusual move on IBM's part, as their tendency has been to ticket their products on the high side. Their 20Mb fixed disk, for example, retails for $1595. Aside from speed, the 80286 embodies more exotic and powerful features: a multi-megabyte address space, "virtual" memory, and an extended instruction set. The latter two features provide an atmosphere conducive to multi-user systems design.

The PC/AT is accompanied by another helping of DOS: DOS 3.XX. The version currently available, 3.0, is bigger (32K) and contains several enhancements such as the ability to execute a program at the end of a path name, and fixed disk format protection. DOS 3.1, available in early 1985, will support multi-user situations.

IBM also announced a clutch of other products this month, which I will try to cover in some depth in future columns. The major introductions include the IBM PC Network, a flexible, moderately-priced broadband product which will support voice, video, and data information exchange; two advanced graphics systems (displays, boards, and supporting software); a line of integrated products for the office (accounting and word processing); Topview, a windowing/integrating environment; and a line of inexpensive software for the home user called Personally Developed Software.

I may be one of the few mortals left who has no television set and has never played Trivial Pursuit.

Trivia

I may be one of the few mortals left around who has no television set and has never played Trivial Pursuit. I have strong reasons for the former, but none in particular for the latter; the parties I frequent revolve mostly around less intellectual occupations, like collecting calories. Now, however, those who are addicted to answering obscure questions can do so without having to spend money for Trivial Pursuit, as long as they have already sprung for an IBM PC (or AT or jr).

The game is called *Trivia*, and I will spare you the suspense as to how it is played. Up to six people can participate in round robin fashion and choose from one of the three topics which appear in the cleverly done slot machine windows. The graphics for this game are excellent, and you can turn off the irritating little tunes that accompany the action. There are six categories: sports, general, show biz, true trivia, science, and history/geography. The questions range from fairly simple to extremely difficult, and you can add up to 100 questions to each category. A small bit of help is available: you can ask the computer to fill in one letter, but this reduces the point value of the question by half.

Trivia is copy protected, but you can make one backup copy. I can understand the rage for the party game: one gets an amazing sense of accomplishment from having fished, out of dim cerebral recesses, the answers to such questions as:

- Who sponsored Uncle Miltie's first television show?
- What is another name for the malar bone?
- What is the largest state east of the Mississippi?

This game, by the way, is a member of IBM's Personally Developed Software Series, which is comprised of more than 40 products, all of which are excellent buys. They all share an identical, well-designed command interface and on-disk documentation. I have been grazing among the offerings and will report on several of them next month.

Book Report

Some of us are curious about the tools we use. For those who wonder how compilers and interpreters work, but lack either the patience or the background to wade through the classic compiler construction texts, P.J. Brown's *Writing Interactive Compilers and Interpreters* is highly recommended. Written with charming humor in a relatively nontechnical manner, it is a wonderful introduction to the subject. The first part of the book is a thoughtful discussion of the points to be considered in compiler/interpreter construction. Most of the (very, very short) listings are in Basic or pseudo-code, but don't let this put you off. The simplicity can be deceiving, because the points he makes with the examples illustrate the important concepts well.

The second part of the book wrestles with Reverse Polish, tokens, and other exotica characteristic of computer languages. The book does not supply enough detail for a serious project, but the foundation laid with part two is strong enough to support any number of secondary advanced texts on the subject.

An Update

Although it is September in Baltimore, the weather has been so chilly that I have had to rummage around and find the winter quilts (under one of which I am currently huddled). In an effort to keep exposed members warm, I played around with the Microsoft *Flight Simulator* version 2.0. The new version supports dual joysticks or a mouse, and I dutifully tried out both configurations in the hopes that one or the other would miraculously produce the perfect landing.

Alas, the extra hardware was more of a bother than anything. The mouse is used to point to, and change, several of the instrument panel dials. The response is sluggish and slightly unpredictable. The joysticks suffered from the opposite problem: one little movement sends the elevators, throttle, and ailerons into wild movement.

You have a choice of using one or two joysticks; the first one for the elevators (Y-direction) and ailerons (X-direction), and the second for the throttle. The throttle and elevator controls require non-centering control, but the ailerons are better off if they will automatically recenter. I found myself having to polish my fingers on sandpaper before touching the sticks. The keyboard, in both my opinion and the revered opinion of a devout *MFS* acolyte, remains the input device of choice for this game. The new version, by the way, will display colors on an RGB monitor: the usual magenta/cyan/black and white, plus four dithered tints. This is aesthetically more pleasing than the black and white of the older version, but the graphics are still best on a composite monitor.

A Rose is a Rose is a Rose

Occasionally, in a lapse of either good taste or imagination, I have named a subdirectory inappropriately. Rather than go through all the bother of making another subdirectory, copying the files from the first to the second and then removing the latter, I wrote a short program that renames any subdirectory within the current one. There is a bit of a trick involved, so read on.

As you may be aware, there are two sets of file handling function calls available from DOS 2.0. The first set (function calls 12-24H and 27-29H) is identical to that provided in the 1.xx versions of DOS and uses File Control Blocks (FCBs) to refer to files. The structure of FCBs is minutely described in the DOS manual and can best be described as a data area describing the file, part of which can be completed by the programmer (the file name, for example) and part of which DOS fills in with file information (the file size, for example). Before you issue a file handling function call, you must place the address of an appropriately structured FCB in DS:DX.

The new set, which first appeared in DOS 2.0, uses the concept of a "file handle" to refer to a file instead of an FCB. With these calls (3C-46H), you point DS:DX to an ASCII string containing the complete file name terminated with a byte of ASCII 0 and request that the file be either opened or created. If all goes well, DOS will return a handle in AX which you then use to refer to the file in all subsequent manipulations.

The function calls using file handles are simpler and more consistent than the traditional FCB calls. Furthermore, the new set supports path names; the traditional set is limited to accessing files within the current directory. However, there are some advantages to using the older set of calls.

First, if you enter one or two file names on the command line as parameters, COMMAND.COM automatically formats an FCB for each in the Program Segment Prefix. Thus you do not have to go parsing around to find out what was entered and then get a bunch of file handles. Note that if you enter a *path* name on the command line, the FCB will only contain a drive number and you have to get the parameters yourself at 80H in the PSP.

Second, although subdirectories are really files containing the names of files and subdirectories, the new set of calls will not allow you to rename a subdirectory; attempts to do this will result in an error being returned. (You aren't allowed to rename the volume either.) Ergo, if you want to rename a directory, you must regress and use the function calls which were supplied before directories were invented, since the calls don't forbid what they know nothing about (in this case, a file attribute of 10H, which designates a directory).

The program in Listing 1 is very simple. It takes an old and a new name as parameters to the command. An FCB is formatted for each: one at 5CH and one at 5DH in the PSP. To search for files with attributes other than normal (0), you must build an extended FCB by adding a 7-byte prefix to the original. The first byte of the prefix is FFH; this tells DOS it is not a normal FCB. The last byte of the prefix must contain the attribute you want DOS to use when searching for a file. Then, all you need to do is place the address of the first byte of the extended FCB in DS:DX and call the rename function (17H). The file names are in the correct format for this call, so nothing needs to be moved, parsed or handled. The entire program, assembled as a .COM file, takes 86 bytes. ■

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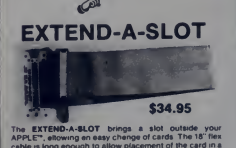

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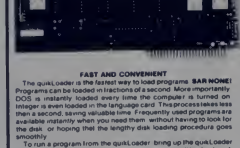

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Other programs available directly from us or the publishers are: **BARKWOTCH I/O TRACER AND SINGLE STEP TRACE, MICRO/TYPOGRAPHER** from **TIDBIT SOFTWARE, ECHO** speech synthesizer software from **STREET ELECTRONICS,** and **MERLIN** assembler, from **ROGER WAGNER PUBLISHING.** More commercial programs are now in the works

MEMORY CAPACITY

The quikLoader has eight sockets for EPROMs These sockets can accommodate standard EPROMs from 2716 to 27512 These types can be freely intermixed The memory capacity of the quikLoader depends on the EPROMS used. For example, the 2716 can hold 2K of programs, and the 27512 can hold 64K! (Frankly, the current costs of the 27512 is prohibitive,but should come down drastically in the next year.) At this writing, the least cost per-bit is provided by the 2764, which can hold an 8K program. Using these "chips", the quikLoader becomes a 64K ROM. Using larger capacity EPROMs allows it to become a 128K, 256K, or even a 512K card. If more memory capacity is needed, the quikLoader operating system supports multiple quikLoaders

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Since DOS is loaded from the quikLoader every time the computer is turned on, it is not necessary to take up valuable disk space with DOS This will give you more than 5% additional space for programs and data on your disks

ABOUT THE DESIGNER

The quikLoader was designed by Myron Sather, author of UNDERSTANDING THE APPLE][(forward by Steve Wozniak), published by QUALITY SOFTWARE (21601 Marilla Street, Chatsworth, CA 91311-5074)

SYSTEM REQUIREMENTS

The quikLoader plugs into any slot of the APPLE][+ or //e If used in a][+, a slightly modified 16K memory card is required in slot 0 A disk drive is required to save data

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CIRCLE 163 ON READER SERVICE CARD

Listing 1.

```
        Author: Susan Glinert-Cole
        Date  : 9/15/84

        This program renames any subdirectory within the current
        directory only.  Command Line syntax is as follows:

                ALIAS <old name> <new name>

                        ;  MACROS  ;

PRINT           MACRO   TEXT            ; This is macro takes a string offset
                LEA     DX,TEXT         ; as an argument and prints the string.
                MOV     AH,09
                INT     21H
                ENDM

CODESEG         segment para public 'code'

                ORG     100H
MAIN            PROC    FAR
                ASSUME  CS:CODESEG,DS:CODESEG
                ASSUME  ES:CODESEG,SS:CODESEG
                JMP     BEGIN

COMMENT .

                        ;  DATA  ;

FCB             EQU     5CH
EFCB            EQU     FCB-7
ATTRIBUTE       EQU     FCB-1
OK_MESSAGE      DB      'Renamed',0DH,0AH,'$'
ERROR_MESSAGE   DB      'Subdirectory not found',0DH,0AH,'$'

COMMENT .

                        ;  Main Program  ;

BEGIN:          PUSH    DX              ;standard program introduction
                MOV     AX,0
                PUSH    AX
                MOV     BX,EFCB                 ;address of EFCB in PSP
                MOV     BYTE PTR[BX],0FFH
                MOV     BX,ATTRIBUTE            ;address of attribute byte
                MOV     BYTE PTR[BX],10H

;Rename the subdirectory

                MOV     DX,EFCB                 ;Point to EFCB
                MOV     AH,17H
                INT     21H

; Print message

                CMP     AL,0FFH
                JE      ERROR
                PRINT   OK_MESSAGE
                JMP     EXIT

ERROR:          PRINT   ERROR_MESSAGE

;-----------------------------------------------------------------------

EXIT:           RET
MAIN            ENDP
CODESEG         ENDS
                END     MAIN
```

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1a. Title of Publication: CREATIVE COMPUTING
b. Publication No.: 0097814O
2. Date of Filing: 10/1/84
3. Frequency of issue: Monthly
A. No. of issues published annually: 12
B. Annual subscription price: $24.97
4. Complete mailing address of known office of publication: 3460 Wilshire Blvd., Los Angeles, CA 90010
5. Complete mailing address of the headquarters of general business offices of the publisher: 39 E. Hanover Avenue, Morris Plains, NJ 07950
6. Full names and complete mailing address of publisher, editor, and managing editor: Publisher: Claude P. Sheer, One Park Avenue, New York, NY 10016; Editor: Elizabeth B. Staples, 39 E. Hanover Avenue, Morris Plains, NJ 07950; Managing Editor: Peter Fox, 39 E. Hanover Avenue, Morris Plains, NJ 07950.
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2. Mail subscriptions	149,073	175,000
C. Total Paid and/or requested Circulation (sum of 10B1 and 10B2)	239,182	269,300
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Keeping your programs safe from BREAKage

This month I'm dedicating my column to a single key on the TRS-80 keyboard: the Break key. With a little judicious POKEing around, it is possible to redefine what this key does. By analyzing how it is done, I shall also be covering some of the basics of POKEing machine code into strings. Although covering the Models I and III explicitly, the technique applies equally to the Color Computer and Model 4.

Can you imagine what life would be like without that good old Break key? Can you imagine trying to debug a program written in Basic without resort to this easy means of escape? It would be akin to writing a program in machine code if you could kiss your code goodbye if it didn't work as anticipated.

While I was working on a program for use in a commercial environment I realized that the Break key represented an enormous risk.

Thankfully, the Break key lets you stop at any point in the program and check to see if things are as they should be, and if not, why not.

That is all well and good during the period a program is being developed and debugged. Once the program is completed, however, the Break key as a means of escape from program execution can be a menace.

A typical reason can be seen in any program that uses disk output. If the program user inadvertently hit the Break key there may be unwritten data lurking in a disk buffer in memory. Buffers such as these are in constant use during disk I/O and are flushed out to disk when full or when the program ends—ends gracefully that is.

It was while I was working on such a program for use in a commercial environment that I realized that the Break key represented an enormous risk in its normal mode of operation. Even though it is simply a matter of typing CONT, the last thing a customer for a specific application wants to know is that it is possible to exit his program without his files being completely updated. In the program I was writing, it was possible to lose only one buffer's worth of information, but I considered even that unprofessional as long as I could do something about it.

Do it with Finesse

To many programmers, the easiest way out is the best—simply disable the Break key altogether and prevent the user from coming between his application and the Basic interpreter. Although this can be an effective solution, it is rather a sledgehammer approach, and I fancied I could do it differently.

What I did was to get the Break key to cause a jump to a specific line number. Thus, the program couldn't be ended except by a predetermined command which would exit gracefully, flushing the disk buffers as it did so. Not only that, but my program would know the Break key had been hit and could provide some appropriate user feedback.

On the Model I under TRSDOS this worked well. The Break key still functioned as an escape, but it took the user back to the command level of my program rather than Basic.

As it turned out, TRSDOS on the Model I is a particularly easy situation to deal with as far as trapping the Break key. Unfortunately, there are now so many operating system environments for the TRS-80 that it is impossible to come up with a single solution that will cover all possibilities.

Operating systems with type-ahead features can be particularly sticky when trying to trap a key. What happens is that you trap the key in real-time with a slick piece of code, then the resident keyboard driver detects the keypress via an interrupt routine and puts the key into the type-ahead buffer despite your separate detection of it.

The key then reveals itself during the time the operating system unloads the type-ahead buffer and your valiant efforts are frustrated. I should say *my* valiant efforts are frustrated, because I have grappled with this problem for hours. Although it is possible to program around any system, the solution becomes specific for just one single operating system and doesn't lend itself well to a more general article like this.

Consequently I shall describe a couple of methods which may need to be further tailored if you are using any esoteric keyboard drivers on your system. Your DOS manual may even tell you explicitly how to disable the Break key during Basic. Follow those instructions before applying these ideas; then you will have total control over the key.

Taking Control

First, the original method I used under TRSDOS on the Model I: This takes advantage of a piece of coding in ROM which causes a RST 40 to occur whenever the Break key is pressed. Obviously, this is perfect for our ends as half the work has already been done. A RST 40 caused by the Break key is a simple matter to detect. The code to do this is shown in Listing 1.

This code assumes that the normal RST 40 continues at address 4BA2 in RAM. This was true under TRSDOS, but is unlikely to be so under any other DOS. To be more accurate, I could have found the address by PEEKing locations 400D and 400E hex (16397 and 16398 decimal), then POKEing the results into locations 0003 and 0004 above.

Also notice that locations 000D and 000E contain the line number 32767 in hex, which was the line in my program which dealt with the Break key. This can be changed to any number so long as neither byte contains a zero or a 22 hex (more on that in a second).

All the Basic program had to do was redirect the RST 40 vector, which is a machine code jump instruction at location 400C. When the address of the rou-

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CIRCLE 179 ON READER SERVICE CARD

tine in Listing 2 is POKEd into locations 400D and 400E, the routine will get control every time Break is pressed.

Before telling the computer where to go (as you have always wanted to do), you must know where your routine resides in memory. This is where the technique of string POKEing comes in. The idea is to place the machine code routine inside string quotes in your Basic program. This way you don't have to reserve any memory with the MEMORY SIZE? prompt when you fire up Basic.

The machine code fits snugly inside those quotes as if it were a string, remains untouched by the Basic interpreter and can be saved and loaded along with the program just like any normal string.

Keeping the Interpreter Happy

I should point out that for the code to remain untouched, you must follow a couple of rules to keep the interpreter happy. First, because a byte of 0 signals the end of a Basic line, the machine code inside the quotes cannot contain a 0. Second, because the ASCII code for the quotes containing the string is decimal 34, the machine code cannot contain a 34. (Otherwise it is read as an end quote.)

Finally, you can't edit the line containing the machine code string. That is because any byte greater than 127 is listed as its equivalent token, and, because such tokens are between quotes, the line editor (when it is finished) sends them verbatim to the interpreter rather than as the token it initially found.

Those are the dos and don'ts. Now for the how to. The first thing you need to know is the length of your machine code routine. There is no other magic involved than counting the bytes by hand. Then you set up a dummy string of that length in a Basic line. So, for instance, if your routine was ten bytes long, you would have a line like:

```
100 MC$="........."
```

Use periods rather than spaces to facilitate easy counting. Then you have to find out where that string is in memory. This is done using the VARPTR statement to find the address of the string, then POKEing the machine code into that address from a DATA statement.

To get the routine above into a string you would create a code something like that in Listing 2.

Note that the DATA statement simply contains the decimal equivalents of the machine code subroutine (with no 0 or 34 in sight). Once inside the string in line 100, lines 110 to 130 can be deleted as they have performed their task once and for all. As long as line 100 is not altered via the Basic EDIT command, it can be saved and on restored disk or tape with the machine code intact.

Listing 1.

```
0000   FE01     CP    01       ;RST 40 caused by break?
0002   C2A24B   JP    NZ,4BA2H ;If not, do normal RST 40
0005   CDFE20   CALL  20FEH    ;Print carriage return
0008   AF       XOR   A        ;Clear A register
0009   32F240   LD    (40F2H),A ;Error-trap mode off
000C   11FF7F   LD    DE,7FFFH ;Line number to GOTO
000F   CDC51E   CALL  1EC5H    ;Point to line
0012   C3351D   JP    1D35H    ;Do it
```

Listing 2.

```
100 MC$="....................."
110 MC=PEEK(VARPTR(MC$)+1)+PEEK(VARPTR(MC$)+2)*256
120 FOR X=0 TO 20 : READ Y : POKE MC+X,Y : NEXT
130 DATA 254,1,194,162,75,205,254,32,175,50,242,64,17,255,
    127,205,197,30,195,53,29
```

Once the machine code is in place, it is time to add the Basic code to enable the Break key trapping to take place. Here is an example:

```
110 SV=PEEK(16397):
    SW=PEEK(16398):POKE16397,
    PEEK(VARPTR(MC$)+1):
    POKE 16398,
    PEEK(VARPTR(MC$)+2)
```

This line replaces the RST 40 vector address at 16397 and 16398 (400D and 400E hex) with the address of the string MC$ which now contains the machine code to deal with the Break key. Before installing the new vector address however, it is necessary to save the old vector address (in variables SV and SW). This is done because you don't want the Break key to continue to send the computer off to line 32767 (or whatever you choose) after the program finishes. To prevent this, you simply POKE back the old contents of addresses 16397 and 16398. So your program should end with:

```
POKE 16397,SV:
POKE 16398,SW:END
```

All will then be as it was before your program ran.

Theoretically, the only thing stopping this from running under any TRSDOS-type operating system is the address 4BA2 at locations 0003 and 0004 in the machine code subroutine. This address is the normal RST 40 vector and was a constant 4BA2 for TRSDOS 2.1 to 2.3 on the Model I, but may not be the same under any other configuration.

To be more general, this address should be POKEd into the string after reading the address bytes from RAM. This is dead easy from the example above; variables SV and SW contain the very address in question, so a more watertight piece of code results from following line 110 with:

```
120 POKE MC+3,SV:
    POKE MC+4,SW
```

Then if a RST 40 occurs which was not caused by the Break key (such as a disk I/O primitive), the RST 40 is sent on its correct path.

Well, there you have the basics of trapping the Break key at the simplest level. Next month I'll finish the subject with a look at a second method—a machine code routine that intercepts the keyboard before it is read by redefining the keyboard driver address in the device control block (DCB). I'll also be looking at a similar routine for the Color Computer. ■

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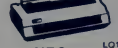

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CIRCLE 137 ON READER SERVICE CARD

ROBERT ALONSO

COMMODORE'S PORT

Making Machine Language Easy

Hello Commodorians. I have finally made it to the big leagues. Writing this column for Commodore owners in *Creative Computing* this month is quite a thrill.

Speaking To Your C 64

This month I include a machine language source file for a sprite demo program and a Basic loader that will let you use the demo without an assembler. These programs are my attempt at helping you become fluent in the machine language, the native tongue of the 64.

If you have taken a look at Listing 1, you may be wondering if that is really machine language when it looks so much like Basic. There are line numbers and comments and even variable-like structures. Welcome to the world of Pal 64.

Pal 64 is probably one of the most advanced assemblers available for the Commodore 64. Pro-Line Software of Mississauqua, Ontario distributes it. It has features that make machine language programming as easy as Basic.

No, I'm not kidding. You type in your machine language from the built in Basic editor of the 64. That means that you can use line numbers and go anywhere on the screen and make changes without the hassles to which some other assemblers subject you.

Pal 64 is a "symbolic assembler," and thus allows you to branch and jump to subroutines by name. For example, if you have a subroutine that loads data bytes into a section of memory you might label it LOADER and call it with a JSR LOADER.

Take a look at line 335 of Listing 1 to see what I mean.

To use Pal 64, you just load it, run it, type NEW, and forget it is there. You include a SYS 700 as the first command in your program and then program for as long as you want. You can then save your work as if it were Basic and load it back in at another time.

Pal 64 is probably one of the most advanced assemblers available for the Commodore 64.

But what makes Pal 64 truly friendly, especially to a beginner, is that when you are ready to assemble your source code into machine code, all you have to do is type RUN—a feature that eliminates much of the anxiety that machine language engenders.

After the program is assembled (a matter of seconds in most cases) you can SYS to the start address of the machine code and see the results instantly.

Listing 1.

```
100 OPEN 2,8,2,"FINAL.OBJ,P,W"
105 SYS 700:.OPT O2:*=$0801
110 ;  ************************
115 ;  *                      *
120 ;  *  CREATIVE COMPUTING  *
125 ;  *    ROBERT ALONSO     *
130 ;  *                      *
135 ;  ************************
140 ;
145 ;  EQUATES
150 ;
155 STOP     = $FFE1
160 CLEAR    = $E544
165 BGCOLO   = $D021
170 SPRITEON = $D015
175 POINTER  = $07F8
180 SPRIDATA = $0340
185 SPCOL    = $D027
190 XPOS     = $D000
195 YPOS     = $D001
200 XPOS1    = $D002
205 YPOS1    = $D003
210 MSIGX    = $D010
215 HORIEXP  = $D01D
220 VEREXP   = $D017
225 ;
230 ;  CONSTANTS AND VARIABLES
235 ;
240 YTIME = $03
245 XTIME = $F0
250 ;
255 ;  CREATE A BASIC LINE
260 ;       10 SYS2061
265 ;
270 .BYTE $0B,$0B     ;LINK 11,8
275 .BYTE $0A,$00     ;LINE #10
280 .BYTE $9E         ;TOKEN FOR SYS
285 .ASC "2061"       ;SYS ADDRESS
290 .BYTE $00,$00,$00;END OF BASIC PRG
295 ;
```

```
300 ;
305 JSR CLEAR          ;CLEAR THE SCREEN
310 LDA #$01           ;CHANGE BACKGROUND
315 STA BGCOLO         ;COLOR TO WHITE.
320 ;
325 ;   SPRITE SET-UP
330 ;
335 JSR LOADER         ;DATA SUBROUTINE
340 ;
345 LDA #$0D           ;SET UP THE SPRITE
350 STA POINTER        ;POINTERS. LIKE
355 LDA #$0E           ;POKE 2040,13 AND
360 STA POINTER+1      ;POKE 2041,14.
365 ;
370 LDA #$03           ;TURN SPRITES
375 STA SPRITEON       ;0 AND 1 ON.
380 ;
385 LDA #$02           ;SET THE COLOR FOR
390 STA SPCOL          ;SPRITE 0 AND
395 STA SPCOL+1        ;SPRITE 1 TO RED.
400 ;
405 LDA #$B4           ;SET X=132 FOR
410 STA XPOS           ;SPRITE 0.
415 LDA #$8B           ;SET Y=136 FOR
420 STA YPOS           ;SPRITE 0.
425 LDA #$B4           ;SET X=180 FOR
430 STA XPOS1          ;SPRITE 1.
435 LDA #$8B           ;SET Y=136 FOR
440 STA YPOS1          ;SPRITE 1.
445 ;
450 LDA #$03           ;EXPAND SPRITES 0
455 STA HORIEXP        ;& 1 HORIZONTALLY.
460 ;
465 ;   JOYSTICK ROUTINE
470 ;
475 JOY = *
480 JSR STOP           ;CHECK STOP KEY.
485 BEQ END            ;END IF PRESSED.
490 ;
495 LDY #YTIME         ;DELAY LOOP TO
500 DELAY LDX #XTIME ;SLOW THINGS DOWN.
505 NEXT DEX           ;YOU CAN CHANGE
510 BNE NEXT           ;YTIME AND XTIME
515 DEY                ;TO SPEED OR SLOW
520 BNE DELAY          ;THINGS DOWN.
525 ;
530 LDA $DC00          ;READ JOYPORT #2.
535 AND #$0F           ;GET LOWER NYBBLE.
540 ;
545 DOWN ROR A         ;TEST BIT 0. OFF,
550 BCC UP             ;GO TO UP ROUTINE.
555 ;
560 LDX YPOS           ;CHECK FOR BOTTOM
565 CPX #$E9           ;EDGE OF SCREEN.
570 BEQ UP
575 ;
580 INC YPOS           ;ALL OK, MOVE
585 INC YPOS1          ;SPRITES DOWN.
590 ;
595 UP ROR A           ;TEST BIT 1. OFF,
600 BCC RIGHT          ;GO TO RIGHT.
605 ;
610 LDX YPOS           ;CHECK FOR UPPER
615 CPX #$31           ;EDGE OF SCREEN.
620 BEQ RIGHT
625 ;
630 DEC YPOS           ;ALL OK, MOVE
635 DEC YPOS1          ;SPRITES UP.
640 ;
645 RIGHT ROR A        ;TEST BIT 2. OFF,
650 BCC LEFT           ;GO TO LEFT.
655 ;
660 LDX XPOS           ;CHECK FOR RIGHT
665 CPX #$F6           ;EDGE OF SCREEN.
670 BEQ LEFT
675 ;
680 INC XPOS           ;ALL OK, MOVE
685 INC XPOS1          ;SPRITES RIGHT.
690 BEQ RSEAM1         ;BRANCH IF SEAM.
695 ;
700 LEFT ROR A         ;TEST BIT 3. OFF,
705 BCC LOOP           ;GO TO LOOP.
710 ;
715 LDX XPOS           ;CHECK FOR LEFT
720 CPX #$19           ;EDGE OF SCREEN.
725 BEQ LOOP
730 ;
735 DEC XPOS           ;ALL OK, MOVE
740 DEC XPOS1          ;SPRITES LEFT.
745 BEQ LSEAM1         ;BRANCH IF SEAM.
750 ;
755 LOOP JMP JOY       ;GO READ JOYSTICK.
760 ;
765 END LDA #$00       ;TURN OFF THE
770 STA SPRITEON       ;SPRITES AND
775 RTS                ;RETURN TO SENDER.
780 ;
785 RSEAM1 = *
790 LDX #$02           ;CROSS SEAM RIGHT
795 STX MSIGX          ;SET THE MOST
800 JMP LEFT           ;SIGNIFICANT BIT.
805 ;
810 LSEAM1 = *
815 DEC XPOS           ;DECREASE PAST 0,
820 DEC XPOS1          ;AVOID FLICKER.
825 LDX #$00           ;CROSS SEAM LEFT
830 STX MSIGX          ;ZERO OUT THE MOST
835 JMP LOOP           ;SIGNIFICANT BIT.
840 ;
845 ;   DATA TRANSFER SUBROUTINE
850 ;
855 LOADER = *
860 LDX #$00           ;ZERO THE OFFSET.
865 POKER LDA DATA,X   ;GET A DATA BYTE
870 STA SPRIDATA,X     ;AND STORE IT.
875 INX                ;INCREASE OFFSET.
880 CPX #$80           ;COMPARE TO 128
885 BNE POKER          ;IF <> THEN POKER.
890 RTS                ;OTHERWISE, RETURN
895 ;
900 DATA = *
905 ;
1000 .BYTE $00,$00,$00
1005 .BYTE $00,$00,$04
1010 .BYTE $00,$00,$04
1015 .BYTE $67,$9D,$CF
1020 .BYTE $B2,$A4,$24
1025 .BYTE $B2,$3B,$E4
1030 .BYTE $92,$21,$25
1035 .BYTE $62,$1B,$E2
1040 .BYTE $00,$00,$00
1045 .BYTE $00,$00,$00
1050 .BYTE $03,$1A,$A3
1055 .BYTE $04,$29,$F2
1060 .BYTE $04,$29,$52
1065 .BYTE $04,$A9,$53
1070 .BYTE $03,$31,$4A
1075 .BYTE $00,$00,$06
1080 .BYTE $00,$00,$00
1085 .BYTE $00,$00,$00
1090 .BYTE $00,$00,$00
1095 .BYTE $00,$00,$00
1100 .BYTE $00,$00,$00
1105 .BYTE $00,$00,$00
1110 .BYTE $00,$40,$00
1115 .BYTE $00,$00,$00
1120 .BYTE $00,$54,$E0
1125 .BYTE $00,$55,$20
1130 .BYTE $00,$55,$C0
1135 .BYTE $00,$55,$00
1140 .BYTE $00,$48,$C0
1145 .BYTE $00,$00,$44
1150 .BYTE $00,$00,$F0
1155 .BYTE $02,$26,$45
1160 .BYTE $46,$94,$44
1165 .BYTE $EA,$94,$44
1170 .BYTE $AA,$14,$54
1175 .BYTE $AA,$0E,$24
1180 .BYTE $A4,$00,$00
1185 .BYTE $09,$00,$00
1190 .BYTE $06,$00,$00
1195 .BYTE $00,$00,$00
1200 .BYTE $00,$00,$00
1205 .BYTE $00,$00,$00
1210 .BYTE $00,$00
```

Moving Creative Computing

Creative Computing is moving. Well, not exactly. If you type in Listing 1 and assemble it or Listing 2 and run it, you will be able to move Creative Computing all over your television screen. Either listing will produce a machine language program on disk that will let you smoothly glide across your screen

A careful look at Listing 1 reveals how easy it is to program in machine language.

two sprites that have been designed to look like the Creative Computing logo.

Listing 1 is a Pal 64 source code file and can be typed exactly as is if you had Pal available to you. Standard Commodore assembly notation is used, so only small changes will be necessary to make it work with another assembler. You may want to omit the remarks to speed up your typing. They are there only to explain what is going on in each line.

Listing 1 creates a program file called FINAL.OBJ on disk. The program file starts with one line of Basic code (10 SYS2061) and the machine code immediately following at location 2061. Lines 270 through 290 are used for the creation of the Basic line.

A careful look at Listing 1 reveals how easy it is to program in machine language. The equivalent of a POKE is demonstrated several times, but specifically pointed out in lines 345 through 360. Storing and transferring sprite data or any other data can be studied in lines 855 through 890. Finally, lines 1000 to the end of the listing are just sprite data values in hexadecimal notation. The data values are in hex because I prefer them that way. PAL 64 allows the use of decimals.

Lines 385 through 395 set the color of the two sprites to red. This is done more as a precaution than anything else, because the only thing that needs to be set to red is sprite 0. When the 64 is first turned on sprite 0 is white and 1 is red. These are factory default values.

If you take a look at lines 405 through 440 you will notice that the two sprites are set 48 pixels apart horizontally. If you consider that a sprite is only 24 pixels wide when you design it, you may think it is odd that they are twice as far apart. The reason for this is that both sprites are expanded horizontally (lines 450-455) which doubles their pixel width.

Listing 2 is provided for readers who don't have an assembler or just prefer to see the results and not worry about details. After you type in Listing 2 save it, insert a formatted disk into your drive or keep the same one that you saved the loader on in the drive, and type RUN.

The program will first read in all the data values and compare them against a checksum in line 155. If the checksum matches the total of all the data values, the program restores the data and initiallizes your disk.

Then the program file called FINAL.OBJ is opened and the error channel is read. If there are any problems, the error will be printed on the screen. Otherwise the data will be sent out to the disk drive, and finally the file will be closed. When all this is done, your screen will display the READY prompt. You can now load in FINAL.OBJ with a comma 8 and run it.

It is worth mentioning that the checksum does not guarantee that the data statements contain no errors. Some errors can offset themselves. For example, if you type 23, 254 in a line where 24, 253 should have been, the error will not be detected because the total is the same. ■

Listing 2.

```
100 REM ********************************
105 REM *                              *
110 REM * CREATIVE COMPUTING LOADER    *
115 REM *        ROBERT ALDNSO         *
120 REM *                              *
125 REM ********************************
130 REM
135 PRINT CHR$(147):POKE53281,0
140 PRINT "THIS PROGRAM CREATES A"
145 PRINT "PROGRAM FILE ON DISK."
150 FOR I=2049 TO 2380:READ A: B=B+A
155 NEXT: IF B<>30254 THEN 240
160 RESTORE:OPEN 15,8,15,"I0":GOSUB 220
165 OPEN 2,8,2,"FINAL.OBJ,P,W"
170 GOSUB 220:PRINT#2,CHR$(1)+CHR$(8);
175 FOR I=2049 TO 2380:READ A
180 PRINT#2,CHR$(A);: NEXT: PRINT
185 PRINT "THE PROGRAM WILL BE CALLED"
190 PRINT "FINAL.OBJ. YOU CAN LOAD IT"
195 PRINT "LIKE ANY OTHER PROGRAM AND"
200 PRINT "RUN IT. THE FIRST LINE WILL"
205 PRINT "BE A SYS TO THE START OF"
210 PRINT "THE MACHINE CODE PROGRAM."
215 GOSUB 220: GOTO 235
220 INPUT#15,ER,ER$,TR,SE
225 IF ER=0 THEN RETURN
230 PRINT ER;ER$;TR;SE
235 CLOSE 2: CLOSE 15: END
240 PRINT CHR$(28)
245 PRINT "THERE IS AN ERROR IN THE"
250 PRINT "DATA STATEMENTS. CHECK"
255 PRINT "THEM FOR ACCURACY.": END
260 DATA 11,8,10,0,158,50,48,54
265 DATA 49,0,0,0,32,68,229,169
270 DATA 1,141,33,208,32,191,8,169
275 DATA 13,141,248,7,169,14,141,249
280 DATA 7,169,3,141,21,208,169,2
285 DATA 141,39,208,141,40,208,169,132
290 DATA 141,0,208,169,136,141,1,208
295 DATA 169,180,141,2,208,169,136,141
300 DATA 3,208,169,3,141,29,208,32
305 DATA 225,255,240,86,160,3,162,240
310 DATA 202,208,253,136,208,248,173,0
315 DATA 220,41,15,106,144,13,174,1
320 DATA 208,224,233,240,6,238,1,208
325 DATA 238,3,208,106,144,13,174,1
330 DATA 208,224,49,240,6,206,1,208
335 DATA 206,3,208,106,144,15,174,0
340 DATA 208,224,246,240,8,238,0,208
345 DATA 238,2,208,240,27,106,144,15
350 DATA 174,0,208,224,25,240,8,206
355 DATA 0,208,206,2,208,240,17,76
360 DATA 72,8,169,0,141,21,208,96
365 DATA 162,2,142,16,208,76,142,8
370 DATA 206,0,208,206,2,208,162,0
375 DATA 142,16,208,76,160,8,162,0
380 DATA 189,205,8,157,64,3,232,224
385 DATA 128,208,245,96,0,0,0,0
390 DATA 0,4,0,0,4,103,157,207
395 DATA 130,164,36,130,56,228,146,33
400 DATA 37,98,24,226,0,0,0,0
405 DATA 0,0,3,26,163,4,41,242
410 DATA 4,41,82,4,169,83,3,49
415 DATA 74,0,0,6,0,0,0,0
420 DATA 0,0,0,0,0,0,0,0
425 DATA 0,0,0,0,0,0,0,64
430 DATA 0,0,0,0,0,84,224,0
435 DATA 85,32,0,85,192,0,85,0
440 DATA 0,72,192,0,0,68,0,0
445 DATA 240,2,38,69,70,148,68,234
450 DATA 148,68,170,20,84,170,14,36
455 DATA 164,0,0,9,0,0,6,0
460 DATA 0,0,0,0,0,0,0,0
465 DATA 0,0,0,0
```

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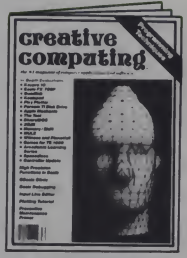

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Timex Sinclair	I	T
Other (specify)	J	U
None	K	V

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DAVID AND SANDY SMALL

OUTPOST: ATARI

Why learn hex; Will Tramiel succeed; and other burning questions

Recently, in this column we have been discussing a few of the secrets of the Atari computer. The first big secret is that everything that happens to the Atari, be it video, sound, joysticks, or keyboard, happens because a memory location is PEEKed or POKEd. You will recall that we spent some time going through many interesting memory locations, noting the effects of accessing these locations.

Why all this emphasis on memory in a series on assembly language? Simply put, assembly language is the art of manipulating computer memory and unless you understand memory, you can't very well learn to manipulate it.

Last month we also mentioned hexadecimal, a method of counting which supposedly helps us to understand memory. Most people find hex awkward at first and wonder if all the trouble is worth it.

So, let me state that unless you become comfortable with hex, you will never accomplish much in assembly language—on any machine. It is that important. Furthermore, if you learn hex for the Atari, you have learned it for all other computers as well, and once you learn hex, you have most of assembly language conquered.

There are quite a few good books around that teach hexadecimal theory and assembly language. To motivate you to buy one, we plan to show you just how easy things are to look at inside the computer once you are familiar with hex.

Let's look at a "memory map." This is a listing of all the really interesting locations of the 65,536 available to a computer. The memory map values in both decimal and hexadecimal appear in Figure 1.

First, and most important, look at how ragged the decimal numbers are. None even ends with zero. Can you remember these numbers easily? I have never been able to. But look at the hexadecimal values. All are nice and even to work with.

Decimal	Hex	Function
65535	$FFFF	
		"F" Operating System ROM (4K or $1000 hex)
61440	$F000	
61439	$EFFF	
		"E" Operating System ROM (4K or $1000 hex)
57344	$E000	
57343	$DFFF	
		"D" Operating System ROM (2K or $0800 hex)
55296	$D800	
55295	$D7FF	
		Unused except in special custom hardware
54528	$D500	
54527	$D4FF	
		ANTIC custom chip: Video and memory control
54272	$D400	
54273	$D3FF	
		PIA chip: Joystick input or possible output
54016	$D300	
54015	$D2FF	
		POKEY chip: Synthesizer and paddle input
53760	$D200	
53759	$D1FF	
		Unused except in custom hardware
53504	$D100	
53503	$D0FF	
		GTIA chip: Video graphics
53248	$D000	
53247	$CFFF	
		Unused except by custom hardware
49152	$C000	
49151	$BFFF	
		RAM: Read / Write Memory
00000	$0000	

Figure 1. Atari Memory Map.

Figure 2. RAM Memory Map.

TOP OF RAM ($BFFF)	
$BFFF	Display Memory (What's on the screen)
?	Display List (The format of the screen)
?	
?	Free Memory Area
?	End of Variable Storage
?	Beginning of Variable Storage
?	End of Program Storage
?	Beginning of Program Storage
$1FD0	
$1FCF	DOS Program & DOS (Disk Operating System)
$0700	File Buffers
	"Page Six"
$0600	
$0500	Various Operating System Data
$0200	Stack
$0100	
$0000	"Page Zero" - Pointers

As an example of this, note anything that accesses the Antic chip begins with the address D4xx. To access the GTIA chip, begin at D0xx. RAM is from 0000 to BFxx. The floating point ROM is at D7xx to DFxx. The OS ROMS are at E000 to FFFF.

Everything works out evenly. Just by looking at the top two digits of the hexadecimal value of an address, you can tell a great deal about what that address does. For instance, the GTIA and Antic chip addresses control memory and video. The PIA chip controls the joysticks. Pokey controls the music synthesizer and paddle controls.

Just by looking at the top two digits of the hexadecimal value of an address you can tell a great deal about what that address does.

If you are looking at some assembly language, and see

```
LDA $D000
```

you know without even seeing the comments that the programmer is doing something with the GTIA chip, which probably means video. Or if you see

```
STA $6056
```

you know that RAM is being accessed.

There are some other memory areas about which you have probably heard and the uses of which will now become clear. First, let me introduce the concept of a memory page. A "page" of memory is 256 decimal bytes. Why 256? It is 100 hexadecimal, an even value. There are 100 hex, or 256 decimal, pages of 256 bytes in the computer; in a four-digit hexadecimal address, the page number is the top two digits, and the address within that page is the last two digits. For instance, in the hex address $1234, the page number is $12, and the location within that page is $34.

As you can see from the memory map, each of the powerful I/O chips has a memory page allocated to it.

Down at the bottom of memory is the popular "page zero." Because of some of the features of the 6502 microprocessor, page zero is a popular place to put "pointers" to other memory locations. These pointers are much like array indexes, like B in A(B) or Z in B$(Z). Page zero is always heavily in demand by applications programs.

Page one is the "stack." This area is used for saving temporary values and "return addresses" during subroutine calls. The stack is the mechanism that helps make a GOSUB jump to the proper place following a RETURN, for instance. If you run the *September* program to view the lowest memory area, you will see the stack jumping around.

Page six, starting at 0600 hex, is a popular place for machine language programs. Synapse Software even sold a set of utilities called *Page Six* for some time.

The disk operating system starts at roughly 0700 hex and continues up to roughly 1FCF hex. The reason the values are inexact is that they vary according to which version of Atari DOS you are using. The size of DOS varies according to how many disk drives you have and how many file buffers you have allocated.

Above DOS we next find an open storage area. Basic uses this to store your program, as does the assembler. Above that are stored all your variables, such as numbers and strings. Above that is empty space into which your program can expand. If you run out of memory, you no longer have space there. Next, you have screen memory, where the Atari keeps a copy of the current TV image, and above that, the special chips and the operating system. See the map in Figure 2.

What is the easiest way to learn hexadecimal? A good book will help, but the only way to become happy with hex is to try working in it. The Atari assembler/editor cartridge is a good bet and a relatively inexpensive one. It includes a program for looking over memory (called Debug) and an assembler that makes machine language programs to POKE into memory. Another good package is the OSS MAC/65 and BUG/65 cartridge or disk assembler from Optimized Systems Software, Cupertino, CA. MAC/65 is much, much faster than the assembler/editor cartridge and a real professional tool.

In terms of hexadecimal and assembler, Basic, especially Atari Basic, is a terrible language to work with. Atari Basic will not let you speak hexadecimal without all sorts of problems; I would not recommend trying assembler programs with it. Instead, use Atari Microsoft Basic or OSS's Basic A+ (a.k.a. Basic XL). Of the two, I recommend the OSS product, as Microsoft Basic lacks support from Atari. OSS Basic is fast and easy to work with and includes several really useful features that you have probably missed in Atari Basic: block delete, cross reference, and renumber.

I hope I have given you some feel for how easy it is to talk to the machine in hexadecimal. Learning hex is very worthwhile, even for a Basic user. It expands your horizons within the machine. It is essential for the assembly language programmer or anyone serious about programming as a career.

Learning hex is very worthwhile, even for a Basic user. It expands your horizons within the machine.

Notes From Sunnyvale

The current hot topic of discussion among Atari users is Jack Tramiel's takeover of Atari and the changes he has implemented there. No one knows if Tramiel can turn Atari around. January 1985 is said to be the date scheduled for the introduction of a new Atari computer. Whether or not it will be the 1450 XLD is open to debate; Atari may not have had the time to develop anything else, and a great deal of work has already gone into the design of the 1450. (Sherwin Gooch, mentioned here in July, is no longer with Atari; Vince Wu, designer of the superb Plato cartridge, is now the 1450 manager.)

1984 saw the end of the old Atari as we knew it. There have been many changes, and many familiar faces are gone: Chris Crawford, Joe Steele, Howard Chan, Fred Thorlin, Bill Galcher, Joe Miller, and Scott Schieman, to name a few of the best. Only time will tell if Atari will survive. As for me, I'll wait until the last computer is sold, the last door is locked, and the last employee turns out the lights before pronouncing Atari finished. I think that somehow they are going to make it.

Finally, we have a favor to ask. *Creative Computing* is changing with the times and the needs and desires of its readers. This includes the evolution of regular departments and columns.

To satisfy your needs and desires, we need to know which columns you read and which ones you want to see continued. So write to us. Let us and the editors know what you want, and we'll all do our best to make this the kind of magazine you want to read.

See you next year! Have a happy holiday season! ■

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Coming Attractions

FEBRUARY

The February issue focuses on all aspects of graphics. You'll find reviews of graphics-oriented products such as the Digital Paintbrush System, Amdek plotter, Mindset computer, and NEC Advanced Personal Computer III. In addition, you'll find in-depth reviews of the new portable Data General/One and Televideo computer system. There is also a section describing the ins and outs of buying an RGB monitor including several programs for evaluating monitors along with short reviews of several new entries.

A special section focuses on telecommunications packages of every imaginable variety. It discusses what to look for, how to buy, and how to get the most out of a package.

In addition to reviews, Michael Crichton steps in with a marvelous computer simulation—complete with program—for simulating the work of artist Josef Albers. Also, for your own computer, we describe an easy approach to doing 3-D graphics and how you can analyze a rainbow!

There are also articles describing the new technology of color LCD displays and new techniques for ultra high resolution printing. And to round out the issue, you'll find your favorite columns including the new Industry Insider and People & Places.

MARCH

Are you looking for ways to get more out of your computer? Our March issue focuses on personal productivity, which we take to mean improving your efficiency both on the job and at home. We'll be looking at software packages that go beyond the standard word processing, spreadsheet, and database packages—programs that really give you an edge in decision making, investing, and personal relations.

And since March is tax time, our special section focuses on tax preparation packages—what you should look for, what each one does, and, most important, whether they can save you money.

The issue will also have reviews of several new computers—too new to mention here—along with all the regular columns and features.

APRIL

As our thoughts turn to new growth in the garden, educators start ordering materials for the next school year and students think about finals and planning for the next year. Thus, this is the month for our semi-annual education issue. In it, we'll take a look at the huge new crop of educational packages—for school, home, and business.

In addition, we'll have in-depth reviews of new computers, peripherals, and software packages. We'll be reporting on the new products from CES; and you'll find all your regular favorite features and columns. ■

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